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Edited by
J. A. MALLETT

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Issued by direction of THE MINISTER FOR AGRICULTURE.

COVER PICTURE

Mount Manypeaks, about 25 miles east of Albany is situated in an area which has an annual rainfall of over 30 inches spread over a "growing period" of 8½ months. This area became the first major settlement on virgin Crown Lands to be established in the south coastal district under the War Service Land Settlement Scheme. Clearing commenced in 1949 and the original area now contains 22 farms carrying up to three sheep per acre on subterranean clover and Wimmera ryegrass pastures.

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Fig. 1.—Tools required for grafting. Left to right: Saw, splitter, secateurs, knives and sharpening stone.

Grafting Fruit Trees

By T. F. HERLIHY, Senior Horticultural Instructor

GRAFTING is a process whereby a portion of one tree is joined to a rooted portion of another and subsequently unites through the mutual response of both stock and scion. Although it is possible to successfully graft and rework some kinds of fruit trees on to others a more successful "take" is assured if the botanical relationship is very close, i.e., peaches grafted on peaches, apples grafted on apples, etc.

However, apricots can be successfully grafted to plum stocks while almonds also do well on peach stocks.

Pears, too, are often sent out from the nursery grafted on to quince stock but only certain varieties are fully compatible and for that reason—together with the possibility that the combination may result in a dwarfed or weak tree—the practice is not recommended.

In an endeavour to assist the less experienced commercial grower and also the home gardener, an easy-to-read chart, showing the compatibility of the various varieties, together with the recommended grafting methods has been prepared and appears in this article. A quick reference to it may save many disappointments and costly failures.

TERMS USED IN GRAFTING

To the experienced grower the terms used in this article are everyday phrases, but to the beginner and home gardener, they may be unfamiliar, therefore a brief explanation of the more essential ones will not be out of place.

Stock—is that part of the tree on which it is intended to graft.

Scion or Scion-material—the mature wood from a tree of the desired variety which will be used to graft on to the stock.

Cambium—is the layer between the bark and the wood. It is the growing tissue which provides for the expansion of both wood and bark.

Callus—is the healing tissue which grows around cut surfaces as a result of the cambium activity.

Rework—to graft an established tree other than a seedling.

Frameworking—method of grafting old established trees when the framework of the tree is retained.

TOOLS REQUIRED

Fig. 1 shows the tools required. They consist of a pruning saw, secateurs, grafting and budding knife, a pocket-size sharpening stone and a combination tool known as a splitter. The latter tool is used for making clefts in the stocks and when withdrawn and reversed the chisel edge is inserted in the cleft to keep it open while the scion or scions are inserted.

It is essential that all tools are kept in first-class condition, clean and with keen edges.

REASONS FOR GRAFTING

The main reasons for grafting fruit trees are as follows:—

(1) To rework old-established trees to more popular and profitable varieties. (See last paragraph of this article.)

(2) To propagate young trees in the nursery rows.

(3) To rework trees which produce fruit that is not true to type, or an unsuitable variety or seedling of poor quality.

(4) To rework late-maturing varieties to early-maturing varieties in an endeavour to minimise losses caused by fruit fly infestation.

(5) To graft whole trees or single limbs to provide for cross-pollination purposes.

TIME FOR GRAFTING

The best time to carry out the work is when the sap has commenced its upward movement and bud swell is noticeable. For apples and pears the period September-October would be suitable while for stone fruits and almonds the work can be commenced as soon as the bark lifts freely from the wood.

For those who have large areas of apples and pears to graft, a commencement during the second week in September would be in order, but where there are only odd trees to be done it would be better to leave the job until the sap is well up, say the first week in October.

Providing the scion material has remained dormant without drying out, the work may be carried out until the end of October or even until the first week in November.

SELECTION OF SCION MATERIAL

The scion material for grafting should be taken from trees which are known to

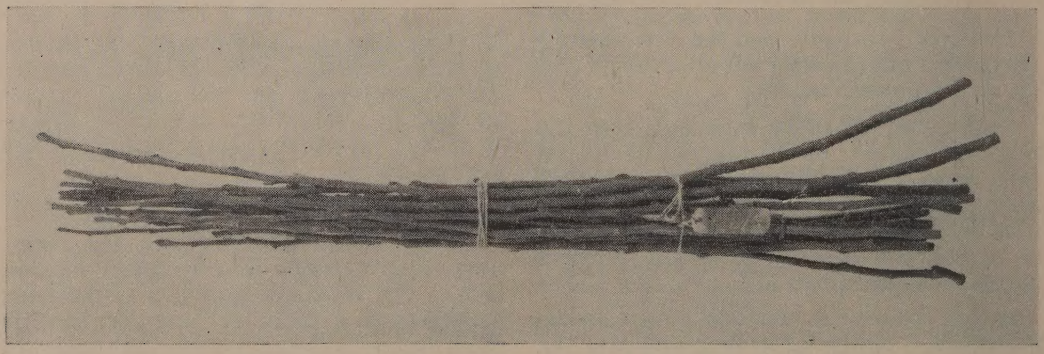

Fig. 2.—Bundle of scion material, tied and labelled ready for storage.

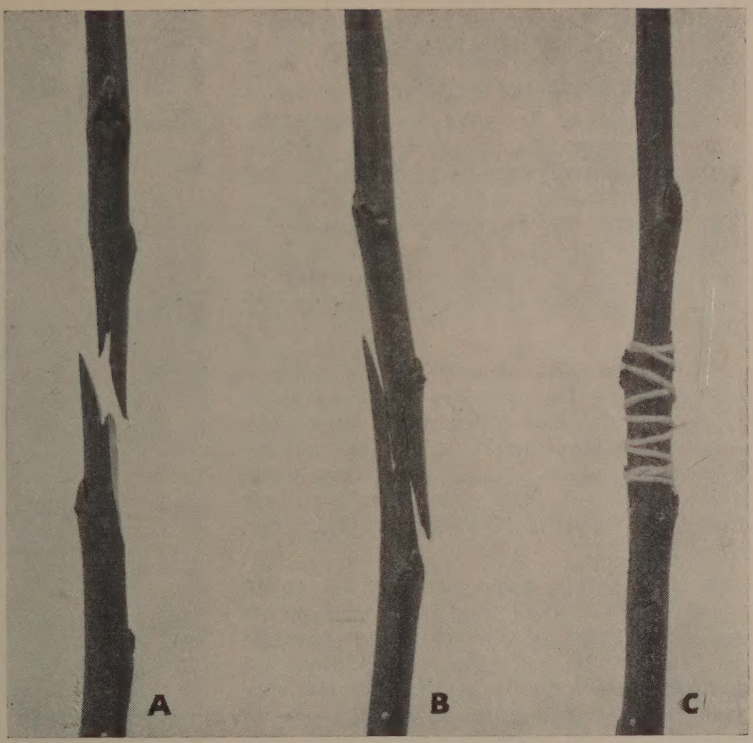

Fig. 3. — Whip and tongue graft, showing A—Stock and scion prepared; B—Placed together; C—Bound ready for sealing.

be regular producers of high quality, true-to-type fruit and to be free from virus or other sap-borne diseases.

As scions for grafting are obtained during the dormant period—while pruning is being carried out—it would be necessary to attach tags in prominent positions during the growing season while the fruit is on the trees. Only scions which are well-grown and have fully-matured buds should be selected.

In some instances, and particularly with apples, the basal buds are often blind.

The top two-thirds of the scion material is the best but for apples, where Powdery Mildew is not a factor, the terminal portion of a shoot can also be used.

The scion material should then be tied neatly in bundles of 30-40 for convenient handling and labelled with metal tags.

The bundles are then buried in moist sand or soil in a cool position or kept in cool storage until required.

If it is intended to keep scions in cool storage for any length of time, regular inspection is necessary as they sometimes tend to dry out.

METHODS OF GRAFTING

There are various methods of grafting fruit trees and their use will vary according to the skill of the operator. Some of the methods are complicated and would be successful only if carried out by persons with a good deal of experience (e.g., the green graft of grape vines is not an easy graft to do, as both stock and scion must be very evenly matched before a perfect union will take place).

For that reason it is intended to mention in this article only those methods which are commonly used by growers in this State, and which can be carried out with confidence by persons who have a limited knowledge of the behaviour of the sap system of the tree to be grafted.

DESCRIPTION AND EXPLANATION OF GRAFTS

Whip and Tongue.

This method is used by nurserymen when propagating young trees, particularly apples and pears by rootgrafting, and also when the diameter of the stocks in the nursery rows is similar to that of the scion it is intended to use. The method is also used by experienced grafters on light lateral growths when frameworking trees.

Rootgrafting is usually carried out indoors during the months of July-August and is sometimes referred to as bench-grafting. It is carried out by joining together a piece of root and scion wood each of which are approximately four inches in length and of similar diameter. See Fig. 3.

A sloping cut approximately 1¼ to 1½ inches in length is made on both pieces and in addition another small cut is made on each of the cut surfaces. This second cut commences about one-third of the way from the tip and runs at a slight angle to the first cut. The two pieces are then joined together as shown, firmly bound with damp raffia or other suitable material and then placed in moist sand for approximately one month to enable them to callus over before planting out in the nursery rows.

When removing the grafts from the callusing bed to the nursery rows it may be necessary to cut the wrapping material, otherwise a restriction in the sap flow may occur and subsequently cause death.

When planting out rootgrafts in the nursery rows it is essential that the point of union be buried well below the soil surface and it may be necessary to leave only the top bud on the scion wood uncovered. When the whip and tongue graft is carried out on above-ground parts of a tree or nursery stock a sealing material of either the bitumastic or wax type is also necessary as a prevention against the entry of air or moisture which would prevent the parts from uniting.

When the subsequent new growth is approximately six inches in length it is important that the wrapping be cut by drawing a sharp knife through the back of the graft.

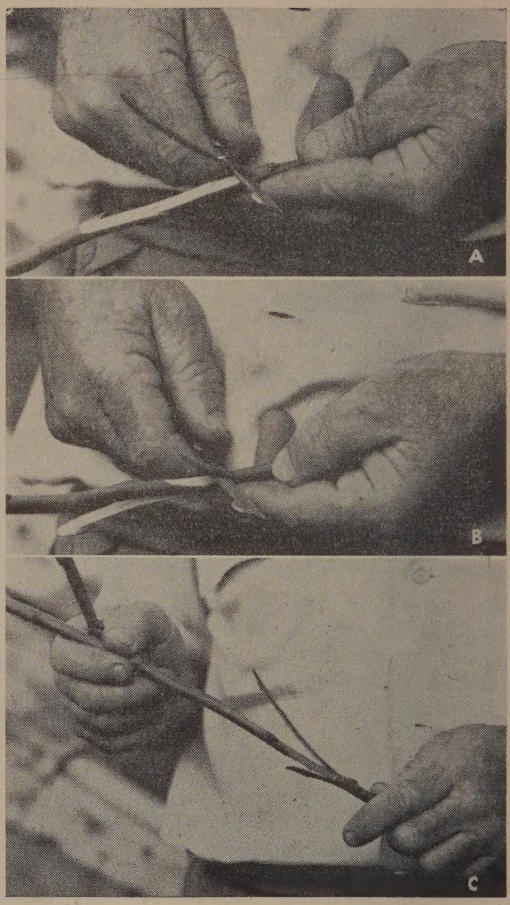

Fig. 4.—Strap graft. A—Cutting the strap portion of the scion; B—Cutting the short wedge on the opposite side of the scion; C—Breaking out the centre.

Strap Graft.

The strap graft is used on limbs which exceed 1¼ inches diameter. This occurs when the main limbs have been cut back for frameworking, or for the provision of cross-pollination branches, or where whole trees have been cut hard back to within a few feet of the ground level for reworking to another variety.

A commencement can be made with this type of graft as soon as the bark lifts freely from the wood. It is a very popular method on account of the rapidity with which the strap grows over the cut sur-

face of the stock thereby causing the union to take place much faster than the cleft graft.

Where the strap graft is used on a number of trees, much more time is taken up in the preparation of the scions as compared with cleft grafting, but the neater union warrants the extra time spent in the preparation.

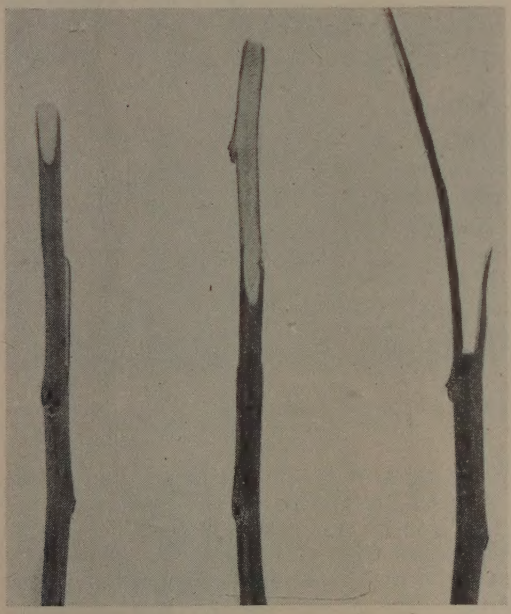

Fig. 5.—Scion prepared for strap graft showing how the bark is removed from the outside tips of both strap and wedge to give close contact with the cambium layer of the stock.

Cutting the Scion.—The scion is held with the terminal bud facing towards the operator. The strap portion is usually cut first and the operator will find it much easier if a part is selected where the knife does not have to pass through a bud. If this is not possible then it is necessary to slightly tilt the cutting edge of the knife inwards when passing under a bud otherwise the blade will slip and the strap will be ruined. The strap will need to be an inch or two longer than the diameter of the stock it has to span, to allow it to be bent over and inserted between the bark and wood. Usually just enough wood is left on the strap to keep it pliable. A sloping cut is then made on the opposite side of the scion wood and finishes directly opposite the point at which the strap cut was completed. The end of the scion is then broken or cut out leaving a shoulder for the scion to sit down on the cut surface of the stock. As it is very important that the cambium layers of both stock and scion come in close contact, a $\frac{1}{2}$ in.-$\frac{3}{4}$ in. piece of bark must be removed from the tip of the strap and short end.

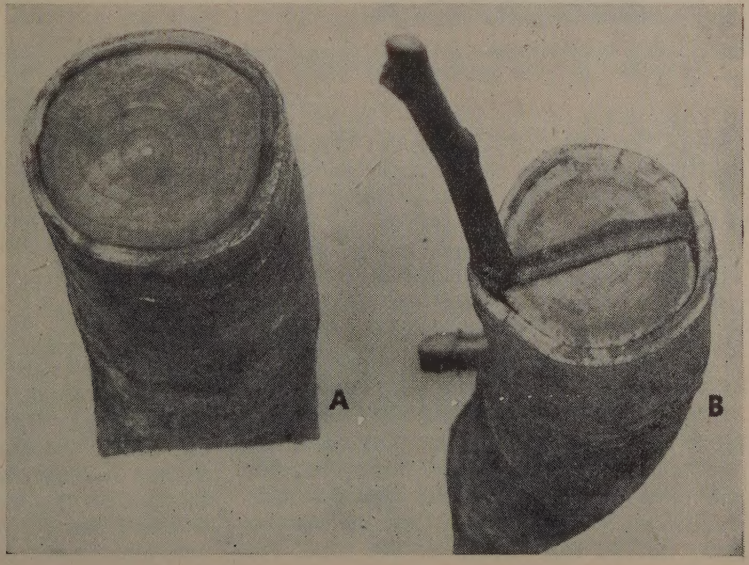

Fig. 6.—Strap graft. A—Shows the stock prepared; B—Shows the graft in position.

Fig. 7.—Strap graft completed except for sealing. Note scion held firmly in position by two tacks.

Preparation of the Stock.—The cut surface of the stock or limb of the tree to be grafted is prepared by trimming the edges with a sharp knife. Make longitudinal cuts approximately 1½ inches in length through the bark commencing at the cut surface. Then with the aid of the knife the edges or flaps of bark are prised away from the wood. The scion is then placed in position by first inserting the strap end of the scion between the bark and wood of the stock on one side and with the strap lying across the surface of the stock the short end is then pushed down between the bark and wood on the opposite side. Care must be taken to see that the strap is lying flat on the surface of the stock (on large limbs it is wise to insert two scions opposite one another with the straps running side by side across the surface). The scions are then fixed firmly in position by using two ⅝ in. or ¾ in. shoe tacks where both ends of the scions were inserted under the bark and if necessary, one tack can be used in the centre of the strap to keep it flat on the surface of the stock. All cut surfaces are then sealed with a suitable material. If a bitumastic preparation such as Colgraft is used, it may be necessary to examine the seals the following day, as cracking sometimes occurs in which case resealing will be necessary. If mastic is used it is wise to cover it with paper as it is often taken away by bees and also as a protection against the sun's rays which often causes it to melt and cause damage to the graft.

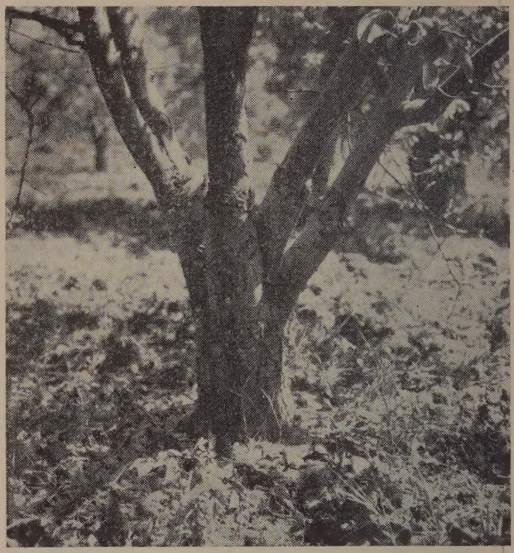

Fig. 8.—A perfect union of a Bartlett pear strap-grafted on to Josephine pear stock.

Cleft Graft.

Cutting the Scions.—A portion of scion wood is selected which has approximately four or five fully-matured buds. At the basal end of the scion—the end which is inserted into the stock—two sloping cuts are made. These are approximately 1½ inches in length, and form a wedge, slightly thinner on the inner edge and with a bud situated on the outside at the point of commencement of the cuts. (Fig. 9.)

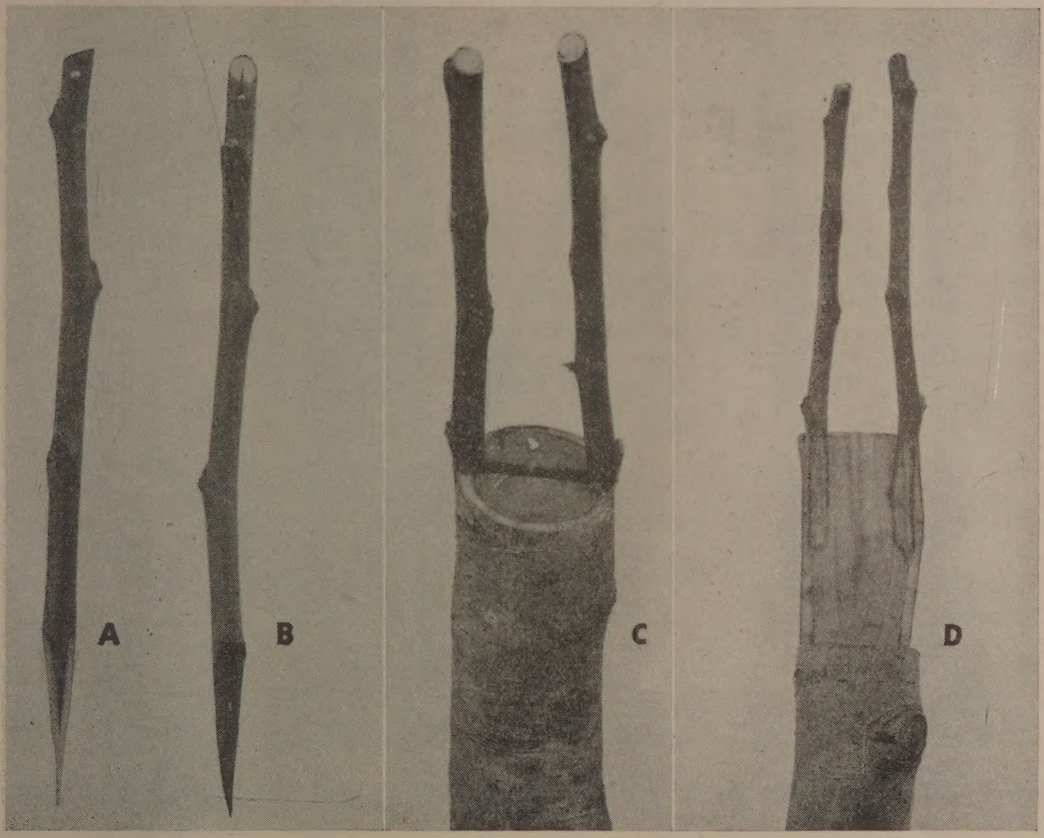

Fig. 9.—Cleft graft. A—The scion is cut in a wedge-shape with the inner edge slightly narrower than the outside so that the cleft closes firmly on the scion; B—Note bud at top of wedge; C—Two scions in position ready for sealing; D—A portion of the stock has been cut away (for demonstration purposes only) to show the positioning of the scions with the cambium layers in contact.

The cleft graft is used on stocks which are less than 1¼ inches diameter, and particularly on stonefruits and grapevines. It is a much quicker and easier graft to perform than the strap graft, but does not callus over as quickly.

It gets its name from the cleft or split which is made in the stock.

Preparation of the Stock.—The stock is prepared in a similar manner to that for the strap graft. The cleft is made across the cut surface of the stock to a depth of approximately, 1½ in. to 2 in. with a sharp-bladed instrument, such as illustrated in Fig. 1, and a mallet or hammer.

The splitter is then withdrawn and the cleft re-opened by inserting the wedge-shaped or chisel end of the splitter. (A large screw driver or wedge-shaped piece of wood will suffice if a splitter is not used.)

As the bark of the stock is invariably thicker than that of the scion, precaution will need to be taken to ensure that the scion is placed so that both cambium layers will make contact.

This will only be done by positioning the scion in towards the wood of the stock so that the cambium of both stock and scion are directly opposite. To expedite callusing it is usual to insert two scions, one on each side of the cleft.

When the instrument used to keep the cleft open is removed, the stock should clamp tightly on the scions and there should be no need for tying. The cut

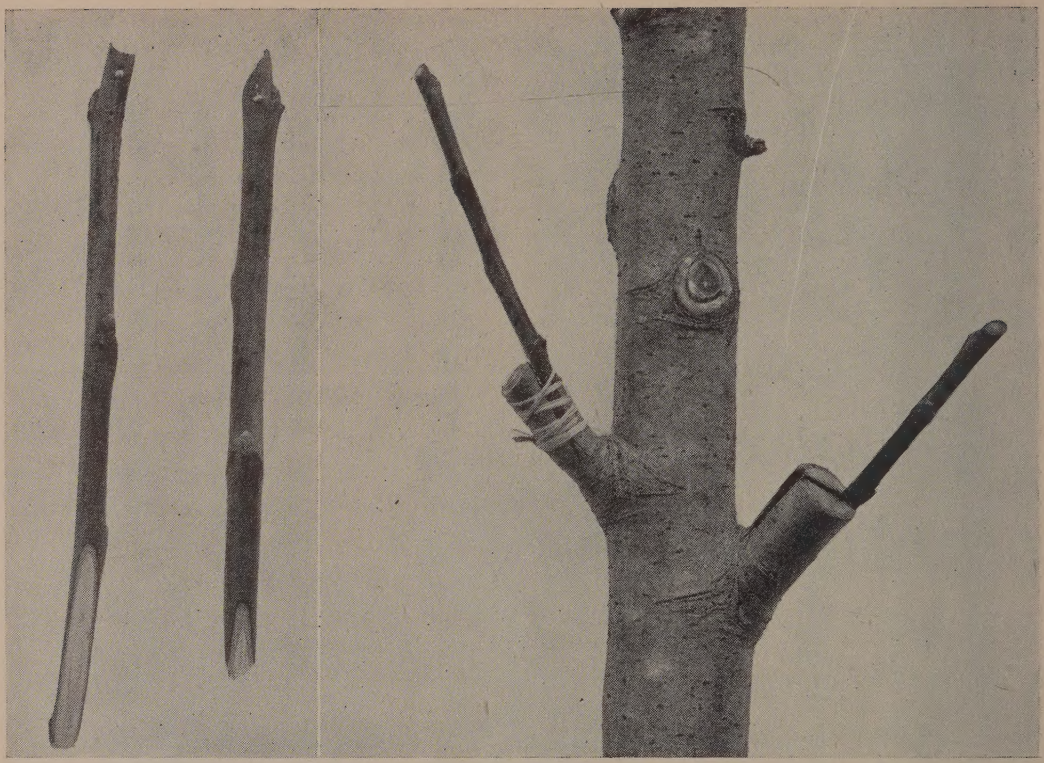

Fig. 10.—Stub graft. A—Prepared scion showing the method of cutting the wedge with uneven (long and short) sides; B—A completed stub graft (left) compared with a single cleft graft (right).

surfaces however, should be thoroughly sealed to prevent the entry of moisture or wood-rotting fungi.

Stub Grafting.

As the name implies, this method of grafting is carried out at the base of lateral or side growths when framework-ing old trees.

This type of graft is ideal where the diameter of lateral growth is ½ in. to 1 in., and is in too awkward a position for a whip and tongue or cleft graft.

A sloping cut approximately 1¼ inches in length is made on the top or side of the lateral growth across the grain and running towards the basal end.

The scion, which is usually four or five inches in length and has at least three fully matured buds, is prepared by making a sloping cut on the one side and a slightly shorter cut on the other. The scion is then inserted in position by a gentle pressure which opens the cut on the stock. When released, the stock closes tightly on the scion and tying is usually unnecessary. If for any reason it is necessary to tie the scion in position, precautions must be taken to cut the material used when the new growth has reached six to eight inches.

Surplus wood or growth of the stock is removed by cutting it away with the secateurs at the point where the scion is inserted. The cut surfaces are then thoroughly sealed.

Bark Graft.

This method is usually used on apricots, apples, pears, figs and citrus fruits.

The stocks are prepared in the same manner as for the strap and cleft graft, but the scion is inserted between the bark and the wood of the stock and then thoroughly sealed. (Fig. 11.)

Fig. 11.—Bark graft. Showing method of preparing the scion.

Preparation of Scion.—The scion is prepared by making a sloping cut approximately 1½ inches long on one side and leaving a shoulder on the opposite side for the scion to sit down snugly on to the stock.

It is essential that the scion should have three or more fully matured buds, one of which should be situated on the bark of the cut surface.

FRAMEWORKING

In recent years it has been found that when an old established tree is cut hard back for reworking, the cut surfaces of large limbs are often infected with a wood-rotting fungus such as *Polystictus* before the graft has time to callus over. Once a fungus gains entrance it is very difficult to eradicate and will ultimately destroy the tree. For this reason frameworking, although much slower, has many advantages, of which the main one is that the framework of the tree is retained, thereby lessening the number of large saw cuts.

In addition, the tree resumes cropping much sooner and fruit quality is not impaired. In frameworking, large cuts are only made when unwanted limbs are removed entirely.

This is depicted in Fig. 12 which shows a portion of a block of old pear trees which were reworked to another variety by the frameworking method.

AFTER CARE

Consideration must be given to provide protection against damage by sunburn to the trunks of trees which have been prepared for grafting.

This is usually done by wrapping bags or some other suitable material around the butts of the trees until such time that the new growth has developed sufficiently to provide natural protection after which the wrapping material is removed. An alternative method is to paint the whole tree with a good whitewash. One of the main disadvantages when bagging, etc., is used, is that it provides a hiding place for the various chewing and sap-sucking insects which could cause considerable damage to, and possible death of buds and tender new shoots if precautionary measures for control spraying are neglected. Vigorous new growth resulting from trees which have been cut hard back and grafted is sometimes blown off at the base by heavy winds. This can be averted by providing a stake on which to tie the new growth.

A NOTE OF WARNING

As the new growth from reworked trees will be governed by the condition of the root system, considerable thought will have to be given by the grower as to whether or not it would be better to replant than rework the existing trees.

Only vigorous, healthy trees should be reworked, and those which are stunted, or are carrying limbs which have died back should not be considered for grafting.

Fig. 12.—Trees frameworked using whip and tongue, cleft and stub grafting. At left is a close-up of two of the branches.

COMPATIBILITY CHART

Existing Tree or Stock	Scion to Use	Recommended Method to Use
Apple	Apple (All Varieties)	Whip and tongue on stocks or lateral growths up to ½ in. diameter. Cleft graft on limbs ¾ in. to 1½ in. diameter. Strap graft on larger limbs. Stub graft on suitable lateral growth when frameworking. Bark graft can be used in conjunction with strap graft on very large limbs.
Pear	Pear (All Varieties)	Same as for apples.
Quince	Quince (All Varieties)	Whip and tongue grafts on growths of similar diameter to scion. Otherwise use the cleft graft.
	Loquat (All Varieties)	As for quince.
	Pear	Not recommended.
Peach	Peach, Almonds, Apricots, Plum (Japanese)	Stocks are usually prepared during the autumn and the subsequent new growth budded during the following summer. Cleft grafts on stocks of suitable diameter. Strap grafts can at times be used on vigorous young peach trees.
	Plum (English)	Not recommended.
Plum (Japanese)	Plum (All Varieties)	Strap, cleft, whip and tongue and bark grafts can be used according to diameter of limb or lateral.
	Apricot (All Varieties)	Grafting not recommended.
Apricot	Apricot (All Varieties)	Cleft and bark grafts or prepare stocks in autumn and bud into the new growth during the following summer.
Almond	Almond (All Varieties)	Whip and tongue grafts where diameter of stock and scion are similar, or Prepare stocks in autumn and bud into new growth during the following summer.
Other Varieties	....	Seek advice of your District Officer.

A horse suffering from "Walkabout Disease" [Photo. by A. L. Rose.]

KIMBERLEY HORSE DISEASE

("Walkabout Disease")

By C. R. TOOP, B.V.Sc., Chief Veterinary Surgeon

FROM the earliest stages of its development, the cattle industry in the Kimberleys has been seriously handicapped by mortality in horses. A plentiful supply of good horses is essential for the successful operation of a cattle station, and when losses occur suitable replacements are often difficult to obtain and they are always costly.

The average station requires about 200 horses for mustering, droving and allied activities, and on one large concern near Fitzroy Crossing the total exceeds 600 head. Conditions for horses in this region are hard at the best of times. Temperatures are usually high and humidity is often excessive. Horses are not only required to work under these conditions but must also live off the country, and as the dry season advances and the quality of the grazing deteriorates, they steadily lose condition.

A large reserve of horses is thus essential to enable mustering and droving plants to be spelled and replaced by fresh horses as their condition declines.

HEAVY MORTALITY

A further and more serious cause of wastage is the mortality resulting from Kimberley Horse Disease or the so-called "Walkabout Disease" which is regarded by cattlemen as the principal cause of loss amongst horses in the northern areas. Official records date back to 1897 when the loss of 122 horses was reported as having occurred on a single property in five months, with a total of 300 deaths in

The two blocks used in this article were made available by courtesy of the C.S.I.R.O.

six years. These losses have continued down the years and it was revealed by Army veterinary officers stationed in the Kimberleys during the War, that 1,419 horses died of the disease on 16 properties between 1942 and 1946.

Cases may be reported at any time of the year, but the majority of deaths occur during the wet season between January and April, and losses are heaviest in unusually wet years.

SYMPTOMS

The most characteristic symptom is an abnormal desire to walk, but this is not observed in all cases. In a typical case the animal appears sleepy and depressed and adopts a peculiar stance with the head depressed, the lips hanging loosely, the eyes half closed and the weight of the body thrown forward over the forelegs. Periodically it commences to walk—aimlessly and generally in a straight line, and may stand pushing its head against obstacles such as trees or fences which impede its progress.

These symptoms may continue for several days until death occurs, and in the final stages the animal becomes prostrate and is unable to regain its feet.

In the more chronic form of the disease, there is a slow but progressive loss of condition and the horse becomes emaciated and lethargic. Some of these cases are rather indefinite but a diagnosis can always be established by the microscopic examination of the liver. A post mortem examination reveals much evidence of liver damage. The pathological changes include necrosis or death of certain groups of cells, haemorrhages into the tissues, and depending on the type of case, a variable degree of fibrosis, but the feature of most significance is a marked enlargement of the liver cells which is described as megalocytosis and is diagnostic.

Investigations by Departmental officers at the turn of the century had suggested that the disease was due to impaction of the stomach, resulting from the consumption of the coarse herbage and the heavy infestations with stomach and bowel worms which were frequently observed, were also thought to play a part.

POISON PLANTS SUSPECTED

The possibility of plant poisoning however, was recognised almost from the outset, and although feeding experiments with suspect plants including the species eventually incriminated were attempted, they were too limited in design and scope to provide any information of value.

WHITEWOOD

The first scientific investigation was undertaken in 1927 and as the result of a series of feeding experiments, they had conducted, it was reported by Murnane and Ewart that Whitewood—a shrub or small tree with a wide distribution in the north had been incriminated. This finding was not, however, accepted by Kimberley cattlemen who were quick to point out that the disease was absent on some properties where Whitewood grew in great abundance, and that losses were heavy on others where it did not occur at all.

It was subsequently shown that Whitewood leaves could be consumed by horses in large amounts with impunity, whereas the seeds even in very small amounts were highly toxic, and it is obvious now that seeds had been included in the plant material fed, and that the condition produced had been mistaken for Walkabout disease. Whitewood seeds are unpalatable and are never eaten voluntarily by horses, so the matter is of no practical significance.

CO-OPERATIVE INVESTIGATION

There the problem rested for more than 20 years and losses still continued, until in 1949, a co-operative investigation by the C.S.I.R.O., the Animal Industry Division, Northern Territory and the Department of Agriculture, Western Australia, was arranged.

The first part of this investigation was concerned with a field survey to define the geographical distribution of the disease and to make a further study of its epidemiology. It ranged over 20,000 square miles and extended from the Victoria River in the Northern Territory to Wyndham and Fitzroy Crossing in the Kimberley Division. This was combined with a botanical survey which involved a vast amount of detailed work in the collection and identification of plant specimens.

These surveys revealed that the disease occurred on some properties but not on others, that its distribution coincided with the major river systems, notably the Fitzroy, Ord and Victoria, and that its incidence was particularly high on areas subject to periodical flooding.

By a comparison of the species listed on affected and non-affected properties and a process of elimination, it was possible to reduce the number of plants that might be incriminated to four, including two species of Indigo and two of Crotalaria. The next step was to conduct feeding trials to determine their toxicity and it was necessary in these experiments to use horses which had never before had access to the vegetation of the area and to ship them, together with supplies of chaff from Fremantle, to Fitzroy Crossing where the work was conducted.

Two of the four suspect plants, *Indigofera trita* and *Crotalaria trifoliostrum* were fed in large quantities for a long period but produced no ill effects and could thus be excluded.

The second species of Indigo—*Indigofera enneaphylla,* commonly known as Birdsville indigo—had already been incriminated as the cause of "Birdsville disease" in Queensland and the Northern Territory, and when fed to a horse at Fitzroy Crossing it produced typical symptoms. It was thus established that Birdsville disease may occur in the Kimberleys as well as in other parts of northern Australia. It grows abundantly in some areas and may cause some deaths but does not appear to be a serious cause of horse mortality in the Kimberley Division.

The only suspect plant now remaining for investigation was *Crotalaria retusa* and because of its geographical distribution it fitted into the picture much more closely than any of the other species studied. Popularly known as the wedge-leaved rattlepod, it reaches a height of about three feet and has clear yellow pea-shaped flowers, and where the soil is suitable for its growth, it occurs in great profusion on areas which become flooded along the river systems. It was abundant on all properties where heavy and frequent losses in horses had occurred and where it was not found in horse paddocks, there was always evidence that affected horses had previously gained access to it elsewhere on the run.

It was also known that closely related species of *Crotalaria* had produced a liver disease in horses in the United States which appeared to be identical with Walkabout disease.

Crotalaria retusa or Wedge-leaved Rattlepod.

FEEDING TRIALS

The plant was fed to two horses during the wet season of 1952 and after consuming about 100 lb. during a period of 70 days, one of them developed typical symptoms of the disease and a microscopic examination of its liver revealed the characteristic pathological changes. Th second horse did not develop symptoms, but an autopsy revealed similar liver damage.

A disease had thus been produced which was similar in every respect to the naturally occurring condition, and *Crotalaria retusa* had been incriminated beyond all

doubt as the plant responsible. This result was subsequently confirmed in a comprehensive series of feeding trials conducted at Katherine in the Northern Territory in which it was shown that horses may need to consume the plant for two and some times three seasons before the disease occurs, and that deaths may not commence until weeks or months after feeding has ceased.

Analyses revealed the plant to contain the toxic alkaloid, monocrotaline, which slowly but progressively damages the liver until symptoms appear and death occurs. The information gained from these studies has enabled preventive measures to be employed. The mature plant is not palatable to horses but it is freely eaten in the seedling stage, and this occurs during the wet season when the majority of station horses are spelling in the horse paddocks.

PREVENTION

Thus by a re-location of horse paddocks or the erection of fencing so as to exclude low lying areas where *Crotalaria retusa* grows abundantly, it is possible to prevent mortality. This practice has been adopted on a number of Kimberley Stations, and it has been reported that the severe losses which occurred in former years have been eliminated.

Access to the plant cannot be prevented during mustering and droving, but by that time it has reached the flowering or seeding stage when it is not eaten and no risk is involved. Several other species of Crotalaria in the Kimberleys might also produce the disease, but because of their distribution or that they are unpalatable, they are probably of little importance.

(From an A.B.C. Country Hour broadcast made available by courtesy of the Australian Broadcasting Commission).

ERRATUM.

In the article on "Stored Grain Pests" in the Journal for November-December, 1957, the recommendation for Cynogas G (page 674, last line) should read "0.05%", not "1%".

FARMERS

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PLANT DISEASES

PINK ROT OF POTATOES

By S. C. CHAMBERS, M.Sc., Plant Pathologist

DURING May, losses of potato tubers from Pink Rot were reported on several properties in the Dardanup, Harvey and Benger districts.

Pink rot of potato is incited by the fungus *Phytophthora erythroseptica* Pethyb and was first recorded in Western Australia at Harvey in 1946. It is favoured by warm wet conditions, but seldom becomes a problem on any property unless potatoes are grown on the same land annually for several years.

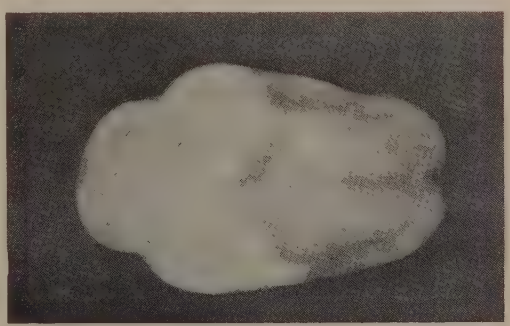
SYMPTOMS

Usually the organism invades tubers by way of the stolons and causes a firm, somewhat leathery decay. When cut and exposed to air, the affected tissue develops an intense salmon-pink colour within an hour, but later this gradually darkens to purplish-brown or nearly black.

Sometimes the fungus attacks the roots and stem bases of potato plants causing a discoloration somewhat similar to that produced by the black-leg disease. A general wilting also occurs, but these symptoms are often overlooked as they only appear late in the season when the plants are already beginning to die down naturally.

SPREAD

The disease is spread mainly by thick-walled resting spores which are produced in large numbers in the affected tissue. These spores are discharged from the decaying tissue into the soil, where they may remain alive for several years and act as sources of infection for future potato crops.



Section of tuber affected with pink rot. The darkened diseased portion was relatively normal in colour when first cut, but developed an intense salmon-pink discoloration within an hour.

Occasionally healthy tubers become infected during storage, if soil adhering to them is contaminated and conditions of storage are extremely damp. However, there is little risk of spreading the disease by "seed" because the decay is so rapid

that affected tubers rot completely before it is time to plant them.

PREVENTION

1. As the disease is soil-borne, a four-year rotation should be practised on contaminated land.

2. Use only clean seed and destroy diseased plants and tubers, preferably by burning, so as to prevent soil contamination.

3. Where necessary improve the drainage of land which has borne a diseased crop.

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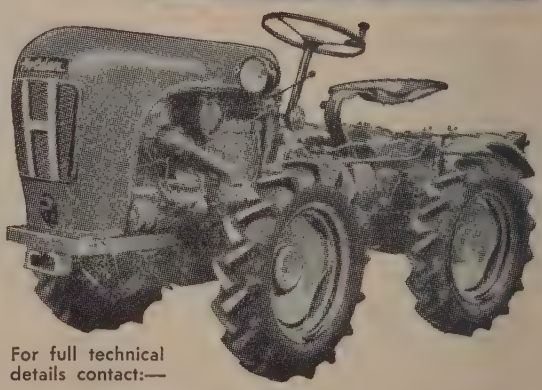

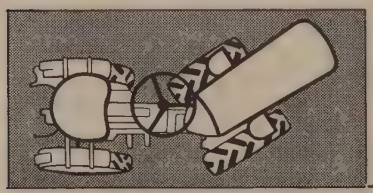

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Cows and calves in the Early Section of the Time of Calving Experiment ("Cranmore Park," Walebing). Photo taken March 5, 1957.

LATE SUMMER and AUTUMN CALVING for BEEF PRODUCTION

(An Experiment at "Cranmore Park," Walebing, 1956-57)

By N. DAVENPORT, B.Sc. (Agric.), Senior Adviser, Meat Production and

H. G. NEIL, B.Sc. (Agric.), District Adviser, Moora

BEEF producers in the agricultural areas are becoming increasingly aware of the importance of calving at a time most suitable to their environment, to the milking ability of the mothers and to marketing practice. The most common time of calving is at the break of the season. The commencement of lactation thus approximates to the advent of the new growth and the cow can make use of the whole of the green pasture period for milk production. By the time the feed has dried off at the beginning of summer the calf is well advanced and able to cope with dry grazing.

A considerable proportion of the surplus drop is sold as calves or weaners during the early summer. By selling at this time, breeders avoid carrying them over the remainder of the dry period when weight losses of varying degrees can usually be expected. It is not surprising therefore that a tendency is developing to market older, heavier animals by calving earlier than usual, even up to three months or so.

Thus weight and development at weaning as affected by the time of calving has become an important aspect of production and marketing.

INVESTIGATION AT "CRANMORE PARK"

In order to obtain information on this question, an experiment was initiated in 1956 at "Cranmore Park." The object is to compare the effect on the growth rate and weaning weight by calving early, i.e., about February as against later about May.

Sixty high-grade Aberdeen-Angus cows were used, ranging in age from two to ten years old, and these were mated to two Beef Shorthorn bulls.

The cows were divided into two groups of 30 with a similar age distribution in each. One group was mated, half to each bull, on April 25, 1956, and comprised the Early Calving section. The other was similarly mated to the same bulls on July 16 as the Later Calving section.

Although the 1956 season was below average, with the result that paddock grazing remaining for the following summer was less than usual, adequate provision was made for the cows during this period until the commencement of

supplementary feeding early in May. The dry grazing was of good quality and comprised subterranean clover, burr trefoil, so-called "native clovers," Wimmera ryegrass and volunteer grasses and other common species.

Weighing.

The cows were weighed immediately before mating; the cows and calves as soon after calving as possible and then at approximately four-weekly intervals until mid November, when the experiment was terminated.

Nutrition and Management.

During those periods between mating and calving when the sections were run separately the grazing was managed to ensure similar nutritional conditions for both sections. All cows were taken off as they calved and were run together for the remainder of the experimental period.

The cows of the early calved section were not fed a supplement either before or shortly after calving, nor were they given preferential grazing.

Most of the cows of the later calving section calved on dry paddock grazing only, for, of the 30 cows only eight calved after the commencement of supplementary feeding on May 10. A grain ration of half wheat, half oats was fed commencing with 5 lb. per day. This was increased to 10 lb. per day over the following ten-day period and continued until June 6. No hay was fed throughout the trial. With the exception of about a fortnight in July on young cereal crops, winter-spring grazing consisted of improved pasture.

1957 was also a season of sub-average rainfall and frosts were numerous during July and August. Although May rains were satisfactory and the June rainfall was abundant, only 349 points were recorded for the remainder of the growing period. Pasture production of the latter part of the season was therefore, well below average. The low spring rainfall had the effect of causing the pasture to mature and dry prematurely very early in October, at least a fortnight earlier than under average conditions.

RESULTS

Calving.

The numbers of male and female calves born in both sections are shown in Table 1.

TABLE 1

Analysis of Calving of Time of Calving Experiment at Cranmore Park, Walebing, 1956/57

Calves	Number of Calves Born	
	Early Section	Late Section
Females	15	10*
Males	13	17
Total	28	27*

* Indicates one calf born deformed and destroyed.

Deaths.

In addition to the slaughter of the deformed calf one cow of the early calving section died during May, three months after calving. The animals involved were not taken into account in the final data.

Weight Data.

The trial was terminated on November 14, as by November each year the marketing of weaners from the agricultural areas has become general. Data showing the relative weight changes and growth rates of the calves of both sections are set out in Table 2. Separate treatment is included for males and females.

The drop was satisfactory in both sections. Calving percentages of 90 and 93 in the early and later calving sections respectively are similar to those usually obtained from the commercial herd on this property. Either one or two cows were barren in each group which indicates that there was no unevenness in fertility between the cows of either section. The bulls were equally efficient and sired the same number of calves in both sections.

All cows, particularly those of the early section lost weight rapidly subsequent to calving and it became necessary to feed a ration of grain for a month before the young green grazing became available.

TABLE 2

Liveweight and Growth Rate Data of Calves of the Time of Calving Experiment at "Cranmore Park," Walebing, 1956/57

Section	Number of Calves	Average Period from Birth to first Weighing	Average Date of Post Calving Weighing	Liveweight at			Weight gain due to Early Calving	Daily Growth Rate for Period			Age at Slaughter from first Weighing
				Post Calving	July 1	Nov. 14		Post Calving to July 1	July 1 to Nov. 14	Post Calving to Nov. 14	
1	2	3	4	5	6	7	8	9	10	11	12
Early Calving (Mated April 15)		days		lb.	lb.	lb.	lb.	lb.	lb.	lb.	days
Females	13	....	Feb. 13	69	236	480	76	1·21	1·79	1·51	274
Males	14	....	Mar. 1	73	228	491	27	1·27	1·93	1·62	258
All Calves	27	1·5	Feb. 21	71	232	486	61	1·24	1·87	1·56	266
Later Calving (Mated July 16)											
Females	17	....	May 17	73	149	404	....	1·69	1·88	1·83	181
Males	9	....	May 2	76	179	464	....	1·72	2·10	1·98	196
All Calves	26	2·6	May 12	74	159	425	....	1·70	1·96	1·89	186

The calves were born strong and healthy and no deaths occurred at or subsequent to calving.

With regard to birth weights, by far the majority of these weighings were made within two days of birth, during which time weight change is quite small. The difference in the average birth weights between the sections is slight, and the level of birth weight is normal. Male calves were slightly heavier than the females in both sections.

At the end of the experiment the liveweight of the calves of the early section was 61 lb. more than that of the later section. When the comparative effect of the sexes on this increase is examined it is seen that the differences between the weights of the females was 76 lb. while for the males it was 27 lb. This was due to the fact that there was three months difference between the average birth dates of the females while, by chance there was a difference of only two months between the males (column 4). Male calves grew faster than females in both sections.

While the growth rate of the calves of both sections was very similar after early July, before then the early calves did not grow as fast in fact about ½ lb. a day less. This was reflected in the average daily growth rates of both sections when considered over the whole experimental period. These rates were 1.56 lb. and 1.89 lb. respectively, a difference of 1/3 lb. in favour of the later calving section.

Liveweight increases from July onwards followed the same pattern for both sections. Average daily rates were 2.0 lb. for July and August, 2.5 lb. for September 1.8 lb. for most of October and falling further to 1.0 lb. for the last three weeks before slaughter on November 14.

It is the usual practice on this property to dispose of the surplus drop, as calves, during late spring and early summer. However, these experimental animals were not sold and their value was assessed from official market quotations. The price of such beef on the hoof at the Midland Saleyards in mid November was 170s. per 100 lb. of carcass. Assuming the dressing out percentage to be 50 per cent. for this type of animal, the liveweight gain of 61 lb. of the early calving section represents 30 lb. of carcass. There was thus an advantage of 50s. a beast by calving in February compared with calving in May.

DISCUSSION

Mention should be made of the fact that although, before calving the cows of both sections were restricted to paddock grazing only, the calves were born robust and of normal weight. Supplementary

feeding until then had not been essential and it is obvious that during the last three months or so before calving the level of nutrition had been satisfactory. However, such a result is not general and breeders commonly find that some degree of pre-natal feeding is necessary according to the value of the grazing in order to ensure a satisfactory calving and development of the milk potential.

The quality of paddock grazing is at its lowest during autumn and at the break of the season and, irrespective of the time of calving, the provision of ample supplements such as grain, hay and silage for feeding during this period is essential to good husbandry practice.

Until the new season's growth became available the daily growth rate of the calves of the early section was only 1.2 lb. while for the calves of the later section it was 1.7 lb. Although the rate of the early calves could have been improved through a more extensive supplementary feeding programme it is very unlikely that this would have been economic. The early calves were healthy and proved capable of making similar weight gains to those of the later section from the time green grazing became available. The average increase of both sections during this period was 1.9 lb. which is quite a satisfactory figure for this environment in view of the early termination of the season.

As there was no difference in treatment throughout the experiment between both sections, the liveweight margin of 61 lb. in favour of early calving was produced at no extra cost. In other words this advantage is due solely to the longer growing period through earlier calving.

It is possible that, with less favourable grazing conditions than existed for this experiment, breeders may find more extensive supplementary feeding necessary for early calving, and hence greater cost to offset against the increased returns.

The growth rate of calves is determined primarily by the amount of milk consumed. Thus calves from grade cows bred from dairy stock can be expected to grow faster than those from the beef breeds. For this reason many producers who practice selling their drop as weaners favour these grade animals as mothers and mate them to a pure-bred bull.

With such a breeding programme and apart from the aspect of weaning at heavier weights there is a tendency to calve quite early so that the calf is sufficiently developed to cope with the increased flow of milk which results from the new seasons pasture. Breeders have found that cows of high milking ability can have trouble in early lactation if the very young calf is unable to cope with the flow of milk.

While calves from grade cows can be expected to be heavier at weaning than those from beef breed mothers, from that time onwards the superiority of the beef breeds asserts itself and calves of full beef blood soon show to advantage in development and conformation.

SUMMARY

An experiment was conducted with beef cattle in the early subterranean clover belt to enquire into the effect on the birth weight, growth rate and weaning weight of calves born early (February) compared with those born later at the usual time (May).

There was only slight difference in birth weight between the early and later born calves.

Until the advent of the new season's pasture, the growth rate of calves of the early calved section was ½ lb. lower than that of the later calved section. From then onwards, growth rates were similar for both sections at the satisfactory average of 1.9 lb. per day over that period. Final weights were affected by the early finish to the season.

Male calves grew slightly faster than females in both sections.

The average weaning weight of the early born calves was 61 lb. greater than that of the later group. This liveweight margin was valued at 50s.

As the cows and calves of both herds received similar treatment, the margin was due solely to earlier calving.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to Mr. P. Lefroy for his valuable advice and very willing assistance in conducting this investigation which because of its nature called for a considerable amount of management and attention to detail.

The general assistance throughout the experiment rendered by Mr. B. Carlin, Agricultural Adviser, Moora, is appreciated.

Finance for purchase and installation of the weighing facilities was made available by the Australian Meat Board and by the Commonwealth Bank.

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INSECT Pests AND THEIR CONTROL

By C. F. H. JENKINS, M.A., Government Entomologist

THE WEBWORM

(*Talis pedionoma* Mayr.)

THE popular name webworm has been applied to a small caterpillar whose depredations in ploughed-in wheat crops have concerned farmers in this State for many years. The first record of the insect as a pest was made by Newman (1927) under the scientific name of Sclerobia tritialis Wlk. and it has been referred to as such in some subsequent Departmental publications. Recent investigations, however, suggest that either more than one species of insect is covered by the term webworm or that the true webworm is a Crambid moth known as Talis pedionoma Mayr.

The matter can be finally settled by breeding adult moths from webworm caterpillars collected in the field but so far attempts to do this have proved unsuccessful. Autumn collections of small moths inhabiting typical "webworm country" have shown a high population of *Talis pedionoma* but other closely allied moths, particularly *T. panteucha,* may also be abundant. The exact identity of the moth may seem to the farmer to be of academic interest only but in actual practice a correct determination will greatly aid in elucidating life history studies of the pest and consequently the development of control measures.

Fig. 1.—Webworm moths (natural size).

DESCRIPTION

The various species of moths which may be implicated are small greyish insects with dark stripes and markings. The wings are closely folded around the body when at rest so that the moths harmonise closely with the background of dry grass or stubble.

The fully fed caterpillar measures approximately ¾ in. in length and is dark greenish-black in colour. Caterpillars may be found on the surface of the ground at night but spend the day hidden in vertical silk-lined tunnels in the soil. It is the silken webbing in these tunnels which has been responsible for the popular name of the insect.

LIFE HISTORY

Many life history details still require investigation, but the adult moths fly in the early autumn and show a preference for old grass paddocks as egg-laying

Fig. 2.—Webworm caterpillars (enlarged).

sites. Barley grass flats are particularly favoured. Caterpillars feed during the winter and apparently restrict their diet to grasses and cereals as opposed to broad-leafed weeds and clover.

When fully fed and with the arrival of warm dry conditions in the spring the caterpillars deepen their burrows and enter a quiescent stage. The exact period at which pupation occurs is not yet known, but this may be shortly before moth emergence in the autumn.

ECONOMIC IMPORTANCE

The importance of the webworm as a pest has increased in recent years owing to the reduction in fallow cropping in many areas. Clean fallow paddocks are not attractive to egg-laying moths and so crops planted on good fallow are never injured. However, where grass paddocks are turned-in and planted to wheat shortly afterwards serious losses may occur.

Webworm damage in wheat crops first manifests itself by the appearance of thin patches in the young crop. These patches may later become completely bare and extend in size to join up with adjacent patches. A superficial inspection of the area may fail to reveal the presence of caterpillars, as these will be hidden in the daytime in their subterranean tunnels. A search amongst the clods around the edges of a bare patch, however, will usually disclose some caterpillars. The small entrance holes to the tunnels, sometimes with a half-eaten blade of wheat protruding, are also characteristic signs to the more experienced observer.

In addition to the damage caused to cereal crops, less conspicuous but very serious losses may also occur in feed paddocks where the caterpillars destroy or adversely affect the growth of various grasses. (Wallace and Mahon, 1952.) The full extent of the damage may be masked by clover, capeweed or other plants but the depletion of true grasses in the pasture may be quite serious. Some idea of the injury which could be caused will be gained from the fact that population samples have revealed approximately half a million caterpillars to the acre in some grass paddocks. (Jenkins and Forte, 1952.)

SUSCEPTIBLE PLANTS

Amongst the commonly grown cereal crops wheat, barley and rye are liable to webworm attack. Oats, on the other hand, appear to be quite immune as numerous observations have been made where wheat has been totally destroyed by webworm and oats in the next drill row have been untouched. In mixed grass and clover pastures clover appears to be entirely ignored but detailed information is not available as to just which type of grasses are preferred, with the exception of barley grass (*Hordeum murinum*) which seems to be first favourite.

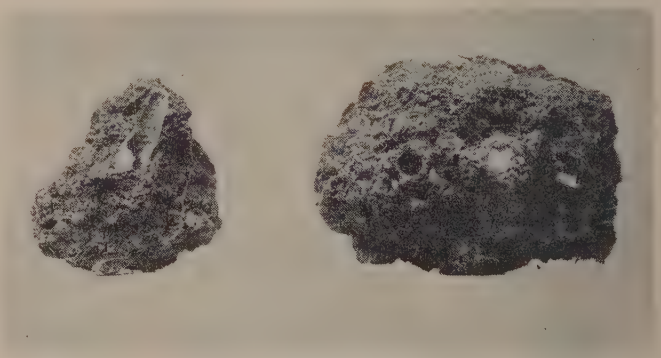

Fig. 3—Left: Webworm tunnel broken open. Right: Two empty tunnels and (centre) an over-summering tunnel closed by webbing.

Fig. 4.—Sod sample taken from dry grass paddock infested with webworm.

CONTROL MEASURES

Fallow

The surest known method of preventing webworm losses on susceptible cereal crops is to plant on clean fallow. For reasons of soil conservation and the greater use of land for stock grazing, there has been a considerable reduction in fallowing operations in recent years and a consequent increase in conditions favourable to webworm activity.

Time of Planting

Time of planting tests (Jenkins and Forte, 1952), indicate that early sown crops are less liable to webworm attack than late ploughed-in crops and that where sowing can be delayed a fortnight or longer after ploughing the likelihood of loss from webworm is further reduced.

Ploughing, as opposed to culivating, in the initial working of the soil is another cultural operation which has proved beneficial. There is also evidence to show that extra cultivation between ploughing and planting may further reduce the hazard of caterpillar injury. Unfortunately in various districts and under some seasonal conditions it may be impossible for farmers to adopt such cultural practices and chemical treatments are then the only alternative.

Rolling, Harrowing and Replanting

Webworm outbreaks are often so patchy and the rate of spread so uncertain that although further extension may cease following harrowing or cultivating, the restricted activity is often associated with the natural habits of the creature rather than any direct effect of the implements used.

Observations on webworm infested areas which were rolled, harrowed or cultivated did not indicate that any appreciable control could be obtained by such methods. Replanting with wheat has proved successful in many cases, but spray protection for the new crop should be applied at the first sign of renewed caterpillar activity.

Chemical Control

A number of the new insecticides have proved toxic to webworm caterpillars, but

Fig. 5.—Effect of D.D.T. on webworm activity. The strip in the left foreground was untreated. It is covered with weeds and almost devoid of wheat plants. On the right is the plot treated with D.D.T. showing high rate of survival of treated wheat plants.

DDT is the most satisfactory so far tried. The recommended dosage is from 6-8 oz. of actual DDT per acre. As a gallon of proprietary 20 per cent. DDT emulsion contains 2 lb. of active ingredient 1 quart of concentrate will be sufficient to treat one acre at the higher concentration.

Proprietary mixtures of malathion and DDT suitable for red-legged earth mite and lucerne flea control may be employed against webworm caterpillars, but an extra pint of 20 per cent. DDT per acre should be added to the 1 oz. DDT, 1 oz. malathion combination normally used for pasture spraying.

Methods and Time of Application

Low volume sprays of various types and aircraft have been effectively used to spray webworm affected crops. The amount of

Fig. 6.—Applying insecticides by means of a low-volume spraying boom.

liquid applied per acre will depend upon the type of equipment used, but rates of 2 gallons and even lower have proved satisfactory with aircraft while many ground units operate efficiently at from 5-10 gallons per acre. The performance of any spray outfit should be carefully tested before treatment is actually commenced in order that accurate calculations can be made in connection with the dilution of the concentrates.

As a guide to the speed of operations it should be noted that a 30 foot boom will cover about 20 acres per hour at 5 miles per hour.

Once a crop has suffered severe webworm injury spray treatments may not ensure satisfactory recovery despite the destruction of caterpillars. For best results therefore sprays should be applied at the first sign of webworm activity.

Spray or dust applications on pasture at top dressing time will give good control of webworm (Anon, 1951), but so far there is no evidence that pre-sowing applications of insecticide will protect a crop.

For pasture protection DDT-superphosphate mixture applied at the rate of 90 lb. of 0.25 per cent. dust per acre during the late summer have given good control and 2 per cent. DDT applied at the same rate has given protection for 2 years.

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CO-OPERATIVE CONTROL OF THE DINGO

By J. HARDIE and R. LUKIS.

VERMIN control measures in the pastoral areas have often been rendered less effective by the existence of a number of Vermin Boards each operating independently of its neighbours. Bonus payments for scalps for instance, have often varied considerably, even between boards with adjoining territories, so that trafficking in scalps was encouraged. Bonus payments by some boards have been excessively high, with the result that shortage of funds has soon compelled a reduction of the bonus rate which in turn has brought about a steep build-up in the vermin population.

FOREWORD

To those who are interested in the pastoral activities of Western Australia, John Hardie and Rob Lukis need no introduction.

The co-operative wild dog drives inaugurated by these two, in company with a few other far-sighted neighbours, have been the greatest advance made in wild dog control for many years.

The drives have been extremely successful, and have formed on outstanding example of the practical application of the mass destruction technique so widely advocated now for vermin control.

Although these drives are now being backed by the Vermin Boards, originally they were quite voluntary, which is indeed a tribute to the originators and all those who now participate.

The Agriculture Protection Board has assisted with the drives, and it has been a pleasure to work with so co-operative a band.

When I suggested to the authors that the benefit of their experience would assist other dingo troubled districts, they willingly agreed to share their knowledge. This interesting article is the result.

A. R. TOMLINSON,
Chief Vermin Control Officer.

After many years of striving to achieve some form of co-ordination, some of the older members of the pastoral community evolved a system of co-operative dingo destruction which has given excellent results, and paved the way for further concerted efforts.

A system of zoning for 32 station properties covering an area of over 20,000 square miles was mapped out. Each zone consists of four to six stations according to geographical position and physical features. The members of each zone select a leader whose responsibilities are:

(a) TO represent the zone in the supervision of doggers engaged in each drive.
(b) TO pay the men employed—and later to collect funds from the other stations in the zone.
(c) TO convene meetings of the zone members to discuss matters in connection with the field work.
(d) TO furnish a report to the field officers of the Agriculture Protection Board at the conclusion of drive.

The co-operation of the Agriculture Protection Board has been an important factor in achieving success. As one pastoralist remarked "Their field officers know a lot about vermin of all kinds, and pastoralists in particular." The Chief Vermin Control Officer visited the area to gain first-hand knowledge of the problems involved and then backed up the efforts of his field officers so that the fullest

possible degree of co-operation was ensured.

The scheme was first proposed to the Agriculture Protection Board in mid-1954 and since then there have been three co-ordinated annual drives throughout the area timed to coincide with the period when the dingo bitches bring their pups down from the ranges to teach them to hunt. On leaving the whelping-grounds they come into large areas that are heavily baited as a result of one hundred per cent. co-operation by all the 32 stations in the area.

Each drive is of one month's duration and known "kills" of 194 dogs in 1955, 172 1956 and 104 in 1957 have been recorded.

Since this scheme has become an annual event the Protection Board in its willingness to help those who try to help themselves, has seen fit to organise a second drive annually during April-May carried out by their field officers and doggers at a time when the mating season of the dingo is in progress. A third drive will be undertaken this year to commence during August-September. A team of doggers under the control of the Protection Board's Regional Vermin Control Officer will hunt and destroy pups and parents in any known breeding areas. This will be known as a "dingo pup drive."

SCHOOLS OF AGRICULTURE—NARROGIN, DENMARK AND HARVEY

Applications are now being invited for the two years' vocational course at the Schools of Agriculture commencing in February, 1959.

Applicants must be between the ages of 14 and 17 years and must have passed the sixth standard of the Primary School curriculum.

Applications must be made on the prescribed forms obtainable on request from the Education Department, Perth, and must be lodged prior to the 1st November, 1958.

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In addition the course is extended to include the following subjects:—

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At Denmark.

Leathercraft.

Students selected for the course are eligible for the living away from home allowance provided their homes are not situated close to the school.

Further particulars may be obtained from the Education Department, Perth.

Beat a Better Batter

By BRENDA CLEEVE

THE word batter is derived from the French word "battre" meaning to beat and as a general rule a good beating improves a batter. The use of modern raising agents is tending to abolish this policy. Batter mixtures are not as popular as previously but they should not be overlooked as the basis for many simple, inexpensive and tasty dishes.

Batter mixtures fall into two groups—pouring batters which form the basis of puddings, both sweet and savoury, and coating batters for covering fruit, meat, fish, etc., before frying.

Most batters are improved by whisking as this helps to make them lighter by the addition of air but where the recipe makes use of raising agents (baking powder or cream of tartar and bicarbonate of soda) this is not necessary and the mixture should only be mixed until smooth. Beating in this case would remove the gas bubbles created by the raising agent and would result in a heavier batter.

Where raising agents are used they should be added just before the mixture is to be cooked. If added beforehand, some of the gas bubbles can escape from the mixture.

Stiffly-beaten egg white should also be added just before cooking to avoid the loss of the air previously beaten into the white, caused by the weight of the other batter ingredients.

Prolonged standing for batter mixtures helps to soften the starch grains in the flour and gives a lighter result.

All batters should be served hot and as soon as they are cooked, as they become leathery if allowed to cool and reheated.

BASIC RECIPE FOR A POURING BATTER

4 oz. flour.
1 egg.
½ pint of milk.
Salt.

BASIC RECIPE FOR A COATING BATTER

4 oz. flour.
½ cup lukewarm water.
1 dessertspoon of melted butter or salad oil.
1 egg—yolk and white separated.
Salt.
1 level teaspoon of baking powder.

GENERAL METHOD FOR BATTERS

1. Sift together the dry ingredients such as flour and salt.

2. Add the egg and any other liquid. Where the batter is to be beaten there is no need to beat the egg first. Fats such as melted butter and oil are added now. As

a rule, especially in the case of a batter which is to be beaten, it is better to add just sufficient of the liquid to make a thick, creamy mixture and then add the remainder when the mixture has been beaten. If all the liquid is added at once the mixture is too thin to be beaten successfully.

3. Beat the mixture until bubbles appear on the surface.

4. Allow the mixture to stand for ½-1 hour.

5. Add any raising agents or stiffly beaten egg whites (according to recipe).

6. Cook and serve immediately.

DISHES MADE FROM A POURING BATTER.

Pancakes are a popular form of sweet and this mixture can be varied quite simply.

Pancakes.

Use the basic recipe for a pouring batter. To cook, heat a little butter in a pan and when hot but not burning pour in three to four tablespoons of the mixture, depending on whether you like a thin or a thick pancake. Thin pancakes are less tough than thick ones. Tilt the pan until the whole surface is covered with the mixture. Cook gently until the top surface is set and the underside is lightly browned. Toss or turn the cake and cook the other side until browned. Turn out of the pan on to sugared paper and roll. Before being rolled the pancake may be sprinkled with more sugar and lemon juice, or spread with a smooth jam or marmalade. If the pancakes are cooked gently so that the surface is not burnt it may not be necessary to grease the pan each time. The easiest way to measure the pancake mixture is to pour the required quantity for each one into a cup and this can be turned into the pan quickly.

Sweet Pancakes.

Add 1 tablespoon of sugar and flavouring essence to the batter mixture.

Lemon Pancakes.

Add the finely grated rind of a lemon and 1 tablespoon of sugar to the basic mixture.

Apple Pancake.

Add 2 tablespoons of sugar to the batter mixture. Pour half the batter into the pan and when it has covered the surface spread over it a layer of grated apple. Pour the remainder of the batter over the top and cook gently until the batter is set and the bottom layer is browned. Brown the top of the pancake in the oven or under the griller. Serve cut into triangles and sprinkled with cinnamon and sugar.

Other fruits such as banana and pineapple may be used in the same manner.

Coffee Pancakes.

Add 1 dessertspoon of coffee essence and 1 level teaspoon of baking powder to the basic mixture.

Savoury Pancakes.

Cook the pancakes in the normal manner using the basic recipe. When cooked spread each one with a mixture of minced bacon (or ham), minced onion and seasoning. Roll up each pancake and place in a piedish or casserole. Pour over a brown sauce or gravy and allow to cook in a moderate oven for 20 to 30 minutes. If preferred, the pancakes can be simmered in a saucepan for the same length of time.

Steamed Batter Pudding.

Place 2 tablespoons of jam, marmalade, or fruits such as currants, cherries, raisins, pineapple, prunes into the bottom of a greased pudding basin. Add 1 tablespoon of sugar to the batter mixture. Pour this into the basin. Cover with greased paper of the lid and steam for 1-1½ hours. This pudding can be cooked in individual moulds and these require ½-¾ hour for cooking. Serve with a sweet sauce, ice-cream or cream.

Date Batter Pudding.

Add 1 cup of chopped dates to the batter mixture and cook as for a steamed batter pudding.

Apple Batter Pudding.

To the basic recipe add 2 tablespoons of sugar and 2 apples which have been peeled and grated, chopped or finely grated. Pour into a greased basin and steam as for the above puddings.

This pudding may also be poured into a greased piedish and baked in a hot oven

for 5 minutes and then in a moderately hot one for ½-¾ hour.

Baked Fruit Pudding.

Use any stewed or tinned fruit kept in large pieces and heated in the syrup.

Make a batter using 1 cup flour, ½ cup of milk, 1 egg and ½ teaspoon baking powder.

Pour about a third of the batter into a well greased piedish. Place the hot fruit in the dish and cover with the remainder of the batter. Bring the syrup from the fruit to the boil and pour over the pudding in the dish. Bake for 5 minutes in a hot oven and finish cooking in a moderate oven.

Orange and Rice Fritters.

Make a batter using 2 oz. of flour, 1 egg, one cup of milk and the grated rind of an orange. Stir in half a cup of cooked, drained rice. To cook, drop in tablespoon heaps onto a hot pan greased with butter. Fry until a golden brown on both sides. Serve sprinkled with sugar. One dessertspoon of sugar may be added. If liked the orange may be omitted and the fritters served with a savoury dish.

Sweet Corn Fritters.

Make fritters as for orange and rice fritters, omitting orange, and sugar and substituting drained sweet corn for the rice.

Nut and Ginger Pancakes.

Use the basic recipe of a pouring batter using half the quantity of liquid. Add 2 tablespoons of chopped nuts, 1 dessertspoon of chopped ginger and 1 tablespoon of sugar. Cook as for fritters.

Potato Pancakes.

Make a batter using 2 tablespoons of milk, 1 egg and 2 tablespoons of flour. Stir in 2 cups of grated potato and a grated onion (small).

Cook as for fritters using a gentle heat to enable the potato to cook.

Meat Pudding.

Make a batter from 1 egg, 1 cup of milk and 1 small cup of flour. Add 1 chopped or grated onion, 1 tablespoon of chopped parsley, salt and pepper.

To this mixture add any left over meat such as mutton or beef, cut into thin slices or small pieces. Place in a greased piedish and bake in a hot oven for 5 minutes and then a moderate one for 15-20 minutes.

This mixture may be steamed in a basin for 1 hour.

Serve with any left-over gravy or a brown sauce.

Cheese Pudding.

Add 2 oz. of grated cheese, a dash of Cayenne pepper and seasoning to the basic batter recipe. Bake as for meat pudding.

Yorkshire Pudding.

Use the basic batter recipe. Melt a tablespoon of fat in a piedish and pour in the batter mixture. Bake in a hot oven for 5 minutes and then a moderate one for ¾ hour or until puffed and dry. This may also be cooked in individual moulds when the time for cooking will be much shorter.

Yorkshire Bacon Pudding.

Before baking the Yorkshire pudding, place strips of bacon on top of the pudding. This dish may be served as a main dish for a light luncheon or breakfast. If preferred the bacon may be chopped and mixed into the batter.

Toad-in-the-Hole.

Place skinned sausages cut into pieces (or cooked meat) into a piedish. Cover with a basic batter. Bake in a hot oven for 5 minutes and then in a moderate oven until the batter and sausages are cooked. If the sausages being used are very fat it is best to partly cook them in boiling water to remove some of this fat. Allow to cool before covering them with batter.

USING A COATING BATTER

Any foods covered in a coating batter should be cooked in fat which is just hot—with a very faint fume rising. If the fat is overheated the batter is cooked through before it has time to rise and the filling food will probably be only partly cooked. This batter may be used to make the following dishes.

Fruit Fritters.

Any firm fruit can be cut into neat pieces and dipped in the coating batter, and fried. Serve sprinkled with sugar. Apples should be peeled and cored and cut into rings about ⅓ of an inch thick. Apricots can be cut in halves and stoned (if fresh). Bananas may be cut into neat pieces if large or if small enough cut in halves down the centre or left whole.

Pineapples should be drained and the slices left whole or cut into halves.

Oranges should be peeled and then cut into slices as for apples.

Fish Fritters.

Use the batter to coat any cooked or fresh fish which has been cut into small pieces.

Meat Fritters.

Cut any left over cooked meat into small thin pieces and dip in the coating batter. Serve with gravy or a brown sauce.

These are only a few examples of the dishes which can be made using the simple batter mixtures. No doubt you will be able to make up some of your own with a little imagination and ingenuity.

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For the seven years 1948-54 when blood-testing was on a voluntary basis the average percentages of reactors were 5.43; 5.65; 5.95; 3.37; 2.53; 1.36 and 0.77 respectively.

The current season's tests show an average percentage of 0.18, the lowest yet recorded. Only 215 reactors were found in a total of 121,222 birds tested.

In the following list of 71 flocks, it will be seen that in no case did the percentage of reactors reach 1 per cent., and just over half the flocks tested showed no reactors.

The breeds of poultry in the flocks are indicated by the following abbreviations: —Australorp A; White Leghorn W L; Rhode Island Red R I R; First Cross X B.

Name and Address	Breeds			No. of Birds Tested	Percentage of Reactors at Last Test
Adams, W. T., Bullsbrook	....	W/L.	....	1,098	0·0
Anderson, P., King Edward Road, Osborne Park	A.	....	X.B.	1,697	0·23
Angle, L., Mount Helena	A.	....	....	755	0·8
Barker, G., Widgee Road, Morley Park	A.	W/L.	....	4,332	0·07
Barnett, T., Cowaramup	A.	....	....	340	0·0
Bell, C. J., Grand Promenade, Morley Park	A.	....	....	2,339	0·17
Bell, N. A., Abernethy Road, Cloverdale	A.	W/L.	R.I.R.	3,342	0·42
Black, G., Katanning	A.	....	....	270	0·0
Butcher, A., Hicks Street, Gosnells	A.	W/L.	X.B.	3,209	0·0
Carter, R. J. and N. H., Eva Street, Maddington		W/L.		1,837	0·0
Chadwick, F., Narrogin	A.	W/L.	....	847	0·97
Charlton, A., Spring Road, Kenwick	A.	....	....	2,648	0·04
Challis, D., Seventh Road, Armadale	A.	....	....	1,822	0·3
Chalmers, H. and D., Acanthus Road, Riverton		W/L.		1,670	0·01
Chalmers, F. E., Acanthus Road, Riverton	....	W/L.	....	1,592	0·0
Cole, H., Division Street, Welshpool	A.	....	....	1,588	0·0
Cook, W. A., Welshpool Road, Welshpool	A.	W/L.	....	2,970	0·06
Conlon, T., Troy Street, Bassendean	A.			696	0·0
Dabelstein, E. T., Ypres Road, Kelmscott	A.			1,265	0·15
Dadley, M. H., Rockingham Road, South Coogee		W/L.		1,515	0·0
Davey & Sons, Eleventh Road, Armadale	A.	W/L.	R.I.R.	6,365	0·06
Dempster, F. A. R., Wanneroo Road, Wanneroo	A.	....	X.B.	897	0·1
Doyle, A. E. & A. M., King Road, Beechboro	A.	....	....	2,564	0·15
Fawkes, A., Wyatt Road, Bayswater	A.	W/L.	....	2,491	0·32
Fenton, J., North Lake Road, Melville	A.	W/L.	R.I.R.	2,434	0·12
Ford, J., Belmont Avenue, Cloverdale	A.	W/L.	X.B.	1,603	0·31
Freeth, J., Kellerberrin	A.	....	....	318	0·0
Gardiner, C., Division Street, Welshpool	A.	W/L.	R.I.R.	2,528	0·11
Gates, A. S., King Edward Road, Osborne Park	A.	....	X.B.	1,627	0·12
Greay, T. S., Division Street, Welshpool	A.	....	X.B.	2,134	0·56
Hampton, A., Scott Street, Kewdale	A.	W/L.	R.I.R.	10,952	0·34
Gregory, A., Victoria Road, Kenwick	A.	....	....	1,450	0·0
Hall, W. G., South Street, Melville	A.	....	....	1,944	0·02
Harris, D., Foss Street, Bicton	Sussex	....	....	12	0·0
Hedges, J., President Street, Kewdale	A.	....	....	1,477	0·4

Name and Address	Breeds		No. of of Birds Tested	Percentage of Reactors at Last Test
Heggie, L., Wanneroo Road, Wanneroo	A.	....	1,489	0·0
Hickson, R., Amherst Street, Swan View	A.	Sussex	480	0·0
Hill, R., Widgee Road, Morley Park	A.	W/L. R.I.R.	2,900	0·03
Hopkinson, A. I., Vale Road, Bushmead	A.	....	1,650	0·12
Hunter Bros., Oats Street, Kewdale	A.	....	498	0·0
Hugall, T., Maida Vale Road, Maida Vale	A.	.... R.I.R.	463	0·21
Johnson, G. T., Katanning	A.	....	127	0·0
Keene, K., Great Eastern Highway, Redcliffe	A.	.... N.H.	118	0·0
Kirwin, F., Nisbet Street, Redcliffe	....	Sussex	13	0·0
Leonard, H., Johnson Street, Mount Helena	A.	....	248	0·0
Miles, R., Wanneroo Road, Wanneroo	A.	W/L. R.I.R.	925	0·0
Muresk College, Muresk	A.	W/L.	331	0·0
McAuliffe, H.	A.	....	165	0·0
McGregor, E. M., Uranium Street, Kewdale	A.	....	1,873	0·05
McIntyre, B., Merredin	A.	W/L. R.I.R.	934	0·0
Oliver, R. E., Welshpool Road, Welshpool	A.	W/L.	1,536	0·0
Parin, A., 11-mile, Wanneroo	A.	....	1,537	0·06
Porter, L. S., Lynstead P.F., Narrogin	A.	W/L. R.I.R.	1,583	0·06
Preston, J., West Swan Road, West Swan	A.	....	235	0·0
Price, E. E., Macedonia Street, Naval Base	....	W/L.	1,682	0·0
Pymn, G., Wanneroo Road, Wanneroo	A.	....	1,578	0·12
Reid, J., President Street, Kewdale	A.	X.B.	1,257	0·31
Roberts, S. G., Cohn Street, Carlisle	A.	W/L.	2,187	0·09
Sears, G., Wanneroo Road, Wanneroo	A.	....	1,674	0·06
Smolenski, W., Oats Street, Kewdale	A.	....	1,197	0·16
Stevens, J., Swan Street, Guildford	A.	W/L. R.I.R.	1,199	0·16
Straw, F. and D. M., Adelaide Street, Maida Vale	A.	....	1,287	0·0
Smith, J. T., Lionel Road, Darlington	A.	....	1,630	0·0
Tyler, A., Beechboro Road, Bayswater . . .	A.	. .	1,492	0·0
Upson & Sons, Pemberton	A.	W/L.	1,603	0·0
Vavra, A., Sydney Road, Wanneroo	A.	....	697	0·14
Wilsheisen, T., Wharf Street, Queens Park	A.	W/L.	1,639	0·0
Whittaker, C., Yale Road, Kenwick	A.	W/L.	4,147	0·05
Woodard, L., George Street, Queens Park	A.	W/L.	2,019	0·05
Woodard, H., Hughes Street, Canning Vale	A.	W/L.	1,971	0·0
Yates, Fulham Street, Cloverdale	A.	W/L.	2,030	0·29

FREE SERVICE TO FARMERS

Do you know that the Department of Agriculture provides a comprehensive service of advice and technical assistance to farmers, free of charge?

When in need of advice, get in touch with your District Officer whose name and headquarters township will be found in the list of Departmental personnel on Pages 378 and 379.

These officers are there to help you and will make personal visits to your property to assist with on-the-spot advice. In addition, they will, where necessary, arrange for the services of specialist officers—all without cost to you.

Fig. 1.—Pyp grass growing on sand-dunes near the mouth of the Margaret River.

PYP GRASS

(Ehrharta villosa)

By F. E. RYAN, B.Sc. (Agric.), Agrostologist

FROM time to time inquiries are received for identification of grass which is found growing near the sea shore. This grass is known as pyp grass (Ehrharta villosa) and is related botanically to veldt grass which is so familiar to visitors to King's Park. It does not resemble veldt grass in its habit of growth and the relationship is mainly in the nature of the seed-head. Unlike veldt grass it spreads by means of underground rhizomes which may stretch for 15 to 20 ft. from the parent plant under suitable conditions. From these rhizomes new shoots occur at 12 to 18 inch spaces along the rhizome and give rise to new plants.

An area of about two acres carrying this grass was located some 12 or 13 years ago by Mr. L. Weston, Forestry Officer at Busselton. It was located on the sand-dunes at the mouth of the Margaret River and on the land side of marram grass which had been planted in the area. In this region pyp grass had naturalised and spread. It was tried near the mouth of Ellenbrook in the same region and there was found to thrive on the poor sandy soils. At Gnarabup marram grass which had been sown on the sand hills failed, but pyp grass grew successfully right down to the shore line.

Mr. T. Lennox of Ellenbrook has planted this grass on sand-dunes on his property with a fair amount of success. Throughout this region of country other patches are known and the grass has become more or less naturalised and is spreading over an area six miles long and several

Fig. 2.—A prolific growth of pyp grass alongside a track in the Margaret River area.

miles wide. Other plantings of this grass have been made at Ludlow and Hithergreen where the grass has established successfully, but has not spread to any extent.

Experimental plantings made on sandhills in the vicinity of Rockingham grew vigorously and produced underground rhizomes 15 ft. in length in one season. Above-ground shoots from these rhizomes reached a height of up to 3 ft.

On the sandy soils at Crawley this grass makes vigorous growth and responds to applications of nitrogenous fertiliser. On heavy loam soils at Wokalup pyp grass survived over a period of four or five years, but failed to make very strong growth and did not spread from the original sowings.

This grass produces coarse green stems with very few short leaves. The green stems are capable of doing the same work of photosynthesis as leaves. It is not very palatable to stock, but sheep appear to develop a taste for it in some conditions and at Crawley stands of pyp grass have been grazed down consistently by sheep.

It is damaged by fire which apparently destroys the shallow underground rhizomes. The grass is obviously useful for sand-binding purposes, on coastal sand-dunes and may provide some grazing for sheep in such areas.

WILD TURNIP

(*Brassica Tournefortii* Gouan.)

Wild turnip is the most widespread and extensive weed of cereal crops in Western Australia. The mature plants break off at ground level and as they are blown around, the seeds are scattered. The advent of the hormone-like herbicides has reduced the significance of Wild turnip as it is easily controlled by these chemicals.

WEEDS of Western Australia

By **G.R.W. MEADLY** M.Sc.
Officer in Charge, Weeds and Seeds Branch

WILD TURNIP

(Brassica Tournefortii Gouan)

ALTHOUGH wild turnip has had a comparatively short history in Western Australia, it is one of the most widespread weeds in this State. Like many of our other annual weeds it is native to the Mediterranean region, but there is no information in literature to suggest that it has become a similar problem in any other country.

The plant was first recorded officially in 1928 when a specimen was received from the Merredin Research Station. There is no doubt that it had then been present in the Merredin and Kellerberrin districts for a number of years and had been confused by many with similar plants such as wild radish and charlock. The manner of introduction is not known with certainty but apparently wild turnip first became established here about 1916 and quite possibly was introduced with fodder imported following the severe drought of 1914.

Prior to 1928, the weed appears to have been restricted to the eastern wheatbelt area already mentioned but in subsequent years its spread was very rapid. Within a short period, besides increasing enormously in extent in the original area, it had become thoroughly established in many other districts as far apart as Salmon Gums, Lake Grace, Bonnie Rock, Kulja and Carnamah. Much of this spread can be attributed to the movement of grain, chaff and hay from infested areas, and wild turnip now occurs in most agricultural districts. Its development in the Eastern States followed that in Western Australia and only recently, it was recorded for the first time in New Zealand.

DESCRIPTION

Brassica Tournefortii belongs to the same genus as the garden turnip and the common name is derived from the well-developed taproot which has a decided turnip flavour. In South Australia it is referred to as long-fruited wild turnip while the related *Rapistrum rugosum* is known as short-fruited wild turnip. In Western Australia the latter plant is called Rapistrum weed.

Wild turnip is a winter-growing annual plant which produces a basal rosette of leaves, sometimes exceeding two feet in diameter. Each leaf has a short, wide base and is deeply divided as shown in the illustrations. The stem leaves are much smaller than the basal leaves but, like them, are clothed with conspicuous hairs. The stems, usually about 3 ft., but sometimes reaching 6 ft. in height, are flexuose and branch freely from the base. They are round in section and covered with stiff hairs towards the base. The colour varies from green to violet.

The numerous flowers are small and pale yellow, sometimes with a trace of violet. The narrow, cylindrical pod may reach three inches in length. The two rows of small, spherical, brown seeds are separated by a thin septum and the pod

WILD TURNIP *(Brassica Tournefortii* Gouan).

A—A leaf showing the deep lobing; B—Seedling; C—Flowering and fruiting branches; D—Siliqua or pod; E and F—Showing seeds attached to the pod partition.

is terminated by a beak usually containing one or two seeds. Flowering normally occurs between July and November.

In the rosette stage Wild Turnip can be confused with Capeweed (*Cryptostemma calendulaceum*) but differs in several features. The young Wild Turnip has a decided taproot, along with bristly hairy leaves of an even colour on both sides. The succulent rather turgid leaves,

Fig. 1.—Mature plant of wild turnip, in seed. In this condition the plants break off and are blown about the paddocks shedding seeds over wide areas

as well as the roots, have a decided turnip flavour. On the other hand, Capeweed has soft, hairy leaves, dark green above and grey below. Besides not having the turnip flavour, the roots are more fibrous and numerous. When the flowering stem appears the plants are quite distinct.

SIGNIFICANCE

In its younger stages of growth, Wild Turnip is eaten by stock but has little value for forage purposes. It grows rapidly and the basal rosette of leaves has a smothering effect on other plants. Experiments with hormone-like herbicides described later show clearly the reduction in grain yield brought about by heavy infestations of Wild Turnip. Undoubtedly competition for nutrients and moisture play an important part.

The weed is also very troublesome at harvesting time as the stems are then quite fibrous and approximately the same height as the crop. Repeatedly removing stems from the choked comb of the machine is an arduous job and much cereal grain can be lost in the process. Wild Turnip is a prohibited weed seed impurity in agricultural seeds and reduces the value of cereals as milling grain. When eaten by dairy cows, it can cause a taint of milk.

The rapid spread of the plant has been due to a number of characteristics common to many weeds. Being relatively unpalatable, stock are not a very significant control factor. Each plant produces large numbers of seeds, and, when mature, the main stem trends to break at the base. The spreading and rigid nature of the branches cause the plants to tumble and they are readily blown about the paddocks, scattering seed as they go. Until recent years when more effective control has been possible, plants piled to the height of a fence were a fairly common sight. The seeds do not all germinate the following year, although they are not such a problem as wild radish in this respect.

Besides being spread by such natural means, the distribution of Wild Turnip has also been associated with the movement of farm commodities including stock, machinery and used sacks. Owing to the sticky nature of the seed, used sacks in particular have been an important agency.

CONTROL

Prompt attention when the plant first appears is the only way to be sure of keeping a property free from Wild Turnip. Once established, eradication is extremely difficult, but much can be done to control the weed and minimise its effects.

As with most annual weeds, cultivation is the first line of attack. When fallowing is practised, paddocks should be stocked heavily prior to ploughing in order to take

Fig. 2.—Base of mature plant showing how stems branch separately from the roots

advantage of the fact that sheep will eat the young plants if forced on to them. The fallow should be carried out early before the weed has made much growth and should be further worked if necessary. The following season further control can be obtained by delaying the sowing of the crop until after a free germination of the weed has been induced by autumn rains.

The advent of hormone-like herbicides has reduced considerably the significance of Wild Turnip as a weed. It is now possible for farming operations, including seeding, to be far more elastic, and in a late season it is even practicable to sow dry on infested land in the knowledge that chemical methods can be used later.

The first trials on Wild Turnip in this State with such herbicides were undertaken on light land at Wongan Hills and Dalwallinu in 1950 using the sodium salts of 2,4-D and M.C.P.A. The results were quite spectacular and showed clearly that Wild Turnip is highly susceptible to the hormone-like herbicides. At Wongan Hills, 4 oz. acid equivalent per acre of either formulation gave complete control and increased substantially the yield of the wheat crop. The average yield of the treated plots was 13.2 bushels per acre compared with 8.5 bushels for the untreated control. Corresponding figures for a trial at Dalwallinu were 11.6 and 5.7 bushels respectively. These figures were based on random sampling, but at Dalwallinu where the plots were harvested with a header, the treated sections yielding 12 bushels and the controls 3 bushels per acre. Fifteen per cent. of the yield from the untreated plots consisted of Wild Turnip seed. A relatively high degree of control was also obtained with 2 oz. acid equivalent per acre of both chemicals.

Based on further experimental work and field observations, 4 oz. acid equivalent per acre of any 2,4-D or M.C.P.A. formulation—ester, amine or sodium salt—is recommended. Good results can be expected from somewhat lower rates, particularly of 2,4-D ester, but the level recommended provides a margin of safety for unfavourable conditions. If the crop is undersown with clover M.C.P.A. should be used as the risk of affecting the clover with 4 oz. acid equivalent per acre of this chemical is negligible.

Spraying should be carried out when the crop is 6 to 8 in. high and stooling. The weed is then easier to kill and has had little opportunity to compete with the crop. Furthermore the cereal is at a safe growth stage for spraying and the equipment causes little or no mechanical damage. With low-volume booms the usual volume of application is 5 to 8 gals. per acre, and extensive areas are also being sprayed by aircraft.

LIST OF REGISTERED FERTILISERS, 1957-58

(By H. G. CARISS, Inspector of Fertilisers)

THE Fertiliser Act, 1928-1955, requires all fertilisers sold in this State to be registered annually, the registration year commencing on 1st November each year. A list of fertilisers registered for the current registration year appears in this issue. Departmental inspectors carry out regular inspection and sampling of fertilisers to see that those offered for sale comply with the requirements of the Fertiliser Act, including the registered analyses. The knowledge that this work is being carried out, induces manufacturers, to maintain their fertilisers close to and usually a little above the registered standard.

From the fertilisers registered, unit values, i.e., the average commercial value of each one per cent., of a given ingredient per ton of fertiliser, have been calculated for the various forms of the main fertilising ingredients, nitrogen, phosphoric-anhydride and potash. The values are arrived at from the average of prices quoted for each fertiliser at the time of registration and are as follows:—

	s.	d.
Nitrogen (N) as—		
Blood, blood and bone, bone dust and other animal fertilisers	90	8
Nitrate	52	10
Ammonia	40	0
Urea	36	8
Phosphoric Anhydride (P_2O_5) as—		
Water soluble in superphosphate	12	9
Citrate soluble in superphosphate	12	9
Acid soluble in superphosphate and rock phosphate	7	0
Blood and bone, bone dust and other animal fertilisers	22	8
Potash (K_2O) as—		
Sulphate	18	0
Muriate (chloride)	12	7

From unit values a comparison of the commercial value of fertilisers of similar types can be made. As will be appreciated however, it is not possible to compare, say for example the value of nitrogen in blood and bone with that in sulphate of ammonia.

It should be remembered that unit values are average values arrived at from the prices of all fertilisers registered. The commercial values arrived at from the use of these figures will therefore in some cases be more and in others less than the actual selling price. Other points to be borne in mind are fluctuations which may occur during the year in market values and in the case of mixed fertilisers, e.g., potato manures, the cost of mixing and extra handling which must be added to figures arrived at from the use of unit values.

To calculate the value of a fertiliser from unit values the percentage of each ingredient in the fertiliser should be multiplied by its unit value and the results for each ingredient in the fertiliser totalled. An example of how this can be done and how a comparison of values can be made between fertilisers of similar types is as follows:—

	Nitrogen. %	Phosphoric Anhydride. %
X Brand blood and bone	6.5	10.0
Y Brand blood and bone	5.5	13.0

The unit values of nitrogen and phosphoric anhydride in blood and bone as set out above are 90s. 8d. and 22s. 8d. respec-

tively. The comparative commercial value of X and Y brand blood and bones would therefore be—

X Brand blood and bone—	s.	d.
6.5 units of nitrogen @ 90s. 8d. per unit	589	4
10.0 units of phosphoric anhydride @ 22s. 8d. per unit	226	8
Total value	816	0

Y Brand blood and bone—	s.	d.
5.5 units of nitrogen @ 90s. 8d. per unit	498	8
13.0 units of phosphoric anhydride @ 22s. 8d. per unit	294	8
Total value	793	4

The fertilising ingredients contained in X brand are worth more than those in Y brand and therefore if the two fertilisers were offered for sale at the same price the X brand would obviously be the most economical to purchase.

Buyers of fertilisers are advised to consult the list of registered fertilisers and to ensure that packages containing fertilisers are correctly branded and/or labelled, i.e., carry a copy of the registered brand and name, and in the case of fertilisers contained in packages of one cwt. and under, a label setting out the registered analysis, before purchasing same.

If any doubts about a fertiliser arise enquiries should be made at the Department of Agriculture where information on the provisions and requirements of the Fertiliser Act and advice on matters concerning the use of fertilisers can be obtained.

The following fertilisers have been registered at the Department of Agriculture under the Fertiliser Act, 1928-1955, for the year commencing 1st November, 1957.

Name of Fertiliser	Reg. No.	Registered Brand	By Whom Registered	Nitrogen (N) as				Phosphoric Anhyride (P_2O_5) as				Potash (K_2O) as		Cash Price per ton at Works (W) or on Rails at Perth (P)
				Nitrate	Ammonia	Blood and Bone	Bone Dust	Water Soluble	Citrate Soluble	Acid Soluble	Total	Sulphate	Muriate	
				%	%	%	%	%	%	%	%	%	%	
A. MINERAL														
1. Nitrogenous														
(a) *Nitrogen as Nitrate*														
Nitrate of Soda	93	C.S.M.L.	Cuming Smith Mount Lyell	16·00	....	....	....	....	....	....	....	....	....	£42/5/0 (PW) £43/10/0 (GW) £4/3/10/0 (BW) £8s/0 (cwt.) (PW)
Sodium Nitrate	149	Faulding	F. H. Faulding & Co. Ltd.	16·00	....	....	....	....	....	....	....	....	....	Packets
Nitrate of Soda	160	David Gray's	David Gray & Co. Ltd.	16·00	....	....	....	....	....	....	....	....	....	Packets
Do. do.	188	Symonds ...	E. Symonds	16·00	...	....	....	....	....	....	....	....	....	
(b) *Nitrogen as Ammonia*														Packets
Sulphate of Ammonia	5	Evergreen	Voldemars Ertners	....	20·50	....	....	....	....	....	....	....	....	£41/0/0 (PW)
Do. do.	96	I.C.I.A.N.Z.	Cuming Smith Mount Lyell	....	20·50	....	....	....	....	....	....	....	....	£43/10/0 (GW) £42/10/0 (BW)
														Packets
Do. do.	127	Blue Cross	Agricultural Products Co.	....	20·50	....	....	....	....	....	....	....	....	Packets
Do. do.	139	Jumbo Product	H. & J. Agricultural & Chemical Products Co.	....	20·50	....	....	....	....	....	....	....	....	

Do. do.	147	Faulding	F. H. Faulding & Co. Ltd.	...	20·00	...		....	....		...	..		£2/15/0 (cwt.) (P)
Ammonium Nitrate	148	do.	do. do. do.	...	30·00									
Sulphate of Ammonia	162	David Gray's	David Gray & Co. Ltd.		20·50	...								£6/1/4 (cwt.) (P)
Do. do.	180	Lightning	Cuming Smith Mount Lyell	....	20·50									Packets
														£41/0/0 (PW)
Do. do.	187	Symonds ..	E. Symonds	...	20·50	..								£43/10/0 (GW)
Do. do.	197	Best	William J. Pascoe & Sons	...	20·50									£42 10/0 (BW)
(c) *Nitrogen as Urea*														Packets
Urea 45%	219	B.A.S.F. ...	Henry H. York & Co. Pty. Ltd.		..	.	(As Urea) 45·00							Packets
Urea—N46	119	Blue Cross ...	Agricultural Products Co.				(As Urea) 46·00							£84/7/6 (P)
Urea	159	David Gray's	David Gray & Co. Ltd.				(As Urea) 46·00							Packets
Urea 46%	218	B.A.S.F.	Henry H. York & Co. Pty. Ltd.	...	...	...	(As Urea) 46·00	..						Packets
														£84/7/6 (P)
2. Phosphatic														
(a) *Rock Phosphate*														
Ground Phosphate Rock	29	Cresco	Cresco Fertilisers (W.A.) Ltd.							36·60	36·60			£12/15/6 (PW)
Do. do. do.	41	Sickle	Cuming Smith Mount Lyell	...						36·60	36·60			£12/15/6 (PW)
Do. do. do.	59	Mount Lyell M.L. in diamond	do. do. do.	..						36·60	36·60			£12/15/6 (PW)
Do. do. do.	72	C.S.M.L. ..	do. do. do.											
Do. do. do.	99	"A" in diamond	Albany Superphosphate Co. Pty. Ltd.							36·60	36·60			£12/15/6 (PJW)
(b) *Superphosphate*										36·60	36·60			£12/15/6 (AW)
Superphosphate 23%	12	Cresco	Cresco Fertilisers (W.A.) Ltd.	..	....	.	.	17·00	3·00	3·00	23·00			£13/16/0 (PW)
Florida Superphosphate 23%	39	Sickle	Cuming Smith Mount Lyell					17·00	3·00	3·00	23·00			£13/16/0 (PW)
Superphosphate 23%	57	Mount Lyell	do. do. do.					17·00	3·00	3·00	23·00			£13/16/0 (PW)
Do. do.	70	C.S.M.L.	do. do. do.	...				17·00	3·00	3·00	23·00			£13 16 0(PJW)(GW (PW)
Do. do.	97	"A" in diamond	Albany Superphosphate Co. Pty. Ltd.					17·00	3·00	3·00	23·00			£13/16/0 (AW)
Superphosphate	135	Blue Cross	Agricultural Products Co.					17·00	3·00	3·00	23·00			Packets
Do.	138	Jumbo Product	H. & J. Agricultural & Chemical Products Co.					17·00	3·00	3·00	23·00			Packets
Do.	163	David Gray's	David Gray & Co. Ltd.					17·00	3·00	3·00	23·00			Packets
Do.	184	Symonds ...	E. Symonds					17·00	3·00	3·00	23·00			Packets
Do.	200	Best	William J. Pascoe & Son	..				17·00	3·00	3·00	23·00			Packets
(c) *Rock Phosphate and Superphosphate*														
50/50 Mixture	30	Cresco	Cresco Fertilisers (W.A.) Ltd.					8·50	1·50	20·00	30·00			£13/18/3 (PW)
Do.	40	Sickle ...	Cuming Smith Mount Lyell					8·50	1·50	20·00	30·00			£13/18/3 (PW)
Do.	58	Mount Lyell	do. do. do.					8·50	1·50	20·00	30·00			£13 18 3 (PW)
Do.	71	C.S.M.L. ..	do. do. do.					8·50	1·50	20·00	30·00			£13 18 3 (PJW)
Do.	98	"A" in diamond	Albany Superphosphate Co. Pty. Ltd.					8·50	1·50	20·00	30·00			£13/18/3 (AW)
3. Potassic														
(a) *Potash as Muriate*														
Muriate of Potash	94	Sun ...	Cuming Smith Mount Lyell											
Do. do.	126	Blue Cross	Agricultural Products Co.									58·00		£36/10/0 (PW)
Do. do.	161	David Gray's	David Gray & Co. Ltd.	....	....	...								£38/0/0 (BW)
Do. do.	190	Symonds	E. Symonds	...	..		..					58·00		Packets
Do. do.	196	Best	William J. Pascoe & Son ...	..	...		..					58·00		Packets
				..	....		...					58·00		Packets
												58·00		Packets

(PW) Perth Works (GW) Geraldton Works (BW) Bunbury Works (PJW) Picton Junction Works (AW) Albany Works

Name of Fertiliser	Reg. No.	Registered Brand	By Whom Registered	Nitrogen (N) as				Phosphoric Anhyride (P_2O_5) as				Potash (K_2O) as		Cash Price per ton at Works (W) or on Rails at Perth (P)
				Nitrate	Ammonia	Blood and Bone	Bone Dust	Water Soluble	Citrate Soluble	Acid Soluble	Total	Sulphate	Muriate	
				%	%	%	%	%	%	%	%	%	%	
(b) *Potash as Sulphate*														
Sulphate of Potash	95	Sun	Cuming Smith Mount Lyell	....	....	....	....	....	....	....	....	48·00	....	£43/5/0 (PW) £45/15/0 (GW) £44/10/0 (BW)
Do. do.	143	Jumbo Product	H. & J. Agricultural & Chemical Products Co.	....	....	....	....	....	....	....	....	48·00	....	Packets
Do. do.	164	David Gray's	David Gray & Co. Ltd.	....	....	....	....	....	....	....	....	48·00	....	Packets
Do. do.	189	Symonds....	E. Symonds	....	....	....	....	....	....	....	....	48·00	....	Packets
Nitrogen and Phosphoric Anhydride														
Garden Fertiliser	11	Eclipse	W.A. Meat Export Works	....	....	4·00	....	1·00	2·00	3·00	6·00	....	....	£25/0/0 (W)
Potato Manure "C"	24	Cresco	Cresco Fertilisers (W.A.) Ltd.	....	3·50	....	....	14·00	2·50	2·25	18·75	....	....	£20/7/0 (PW)
														£20/10/6 (PW)
Do. do.	53	Sickle	Cuming Smith Mount Lyell	....	3·50	....	....	14·00	2·50	2·25	18·75	....	....	£20/10/6 (PW)
Do. do.	66	Mount Lyell	do. do. do.	....	3·50	....	....	14·00	2·50	2·25	18·75	....	....	£20/19/3 (GW)
Do. do.	85	C.S.M.L.	do. do. do.	....	3·50	....	....	14·00	2·50	2·25	18·75	....	....	£20/15/9 (PJW)
														£20/10/6 (AW)
Do. do.	111	"A" in diamond	Albany Superphosphate Co.	....	3·50	....	....	14·00	2·50	2·25	18·75	....	....	£25/0/0 (W)
Garden Fertiliser	145	Sound	Cockburn Sound Fertilisers	....	....	4·00	....	3·00	1·00	2·00	6·00	....	....	£25/2/6 (P)
Animal Organic & Mineral	168	Wooltana	Westralian Farmers Co-op. Ltd.	....	....	4·00	....	....	1·00	8·15	9·15	....	....	
Nitrogreen	217	B.A.S.F.	Henry H. York & Co. Pty. Ltd.	....	20·50 (As Ammonium Nitrate)	....	($CaCO_3$) 36·50	....	....	....	....	....	....	£41/0/0 (P)
5. Nitrogen, Phosphoric Anhydride and Potash.														
Garden Manure	1	Evergreen	Voldemars Ertners	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	Packets
Lawn Manure	2	do.	do. do.	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	Packets
Potato "E"	4	do.	do. do.	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	Packets
Potato Manure "A"	22	Cresco	Cresco Fertilisers (W.A.) Ltd.	....	2·50	....	....	13·25	2·25	2·50	18·00	....	5·00	£21/1/9 (PW)
								12·50	2·00	2·25	16·75	....	5·00	£22/8/6 (PW)
Potato Manure "B"	23	do.	do. do. do.	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	£23/13/9 (PW)
Potato Manure "E"	25	do.	do. do. do.	....	3·50	....	....	12·50	2·00	2·25	16·75	....	5·00	£22/8/6 (PW)
Orchard Manure	26	do.	do. do. do.	....	3·50	....	....	13·25	2·25	2·50	18·00	....	5·00	£21/4/3 (PW)
Potato Manure "A"	51	Sickle	Cuming Smith Mount Lyell	....	2·50	....	....	12·50	2·00	2·25	16·75	....	5·00	£22/12/0 (PW)
Potato Manure "B"	52	do.	do. do. do.	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	£23/17/3 (PW)
Potato Manure "E"	54	do.	do. do. do.	....	3·50	....	....	12·50	2·00	2·25	16·75	....	5·00	£22/12/0 (PW)
Orchard Manure	55	do.	do. do. do.	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	£23/17/3 (PW)
Garden Fertiliser	56	do.	do. do. do.	....	3·50	....	....	13·25	2·25	2·50	18·00	....	5·00	£21/4/3 (PW)
Potato Manure "A"	64	Mount Lyell	do. do. do.	....	2·50	....	....	12·50	2·00	2·25	16·75	....	5·00	£22–12–0 (PW)
Potato Manure "B"	65	do.	do. do. do.	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	£23/17/3 (PW)
Potato Manure "E"	67	do.	do. do. do.	....	3·50	....	....	12·50	2·00	2·25	16·75	....	5·00	£22/12/0 (PW)
Orchard Manure	68	do.	do. do. do.	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	£23/17/3 (PW)
Garden Fertiliser	69	do.	do. do. do.	....	3·50	....	....	13·25	2·25	2·50	18·00	....	5·00	£21/10/6 (PJW)
Potato Manure "A"	82	C.S.M.L. ...	do. do. do.	....	2·50	....	....	13·25	2·25	2·50	18·00	5·00	....	£23/1/6 (GW)
Potato Manure "A2"	83	do.	do. do. do.	....	2·50	....	....	12·50	2·00	2·25	16·75	....	5·00	£23/0/0 (PJW)
Potato Manure "B"	84	do.	do. do. do.	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	£24/6/9 (PJW)
Potato Manure "E"	86	do.	do. do. do.	....	3·50	....	....	11·50	2·00	2·00	15·50	8·00	....	£26/13/6 (PJW)
Potato Manure "E2"	87	do.	do. do. do.	....	3·50	....	....	12·50	2·00	2·25	16·75	....	5·00	£23 (PJW)
Orchard Manure	88	do.	do. do. do.	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	£24/6/9 (PJW)
Garden Fertiliser	89	do.	do. do. do.	....	3·00	....	....	8·25	1·50	1·50	11·25	15·00	....	£25/1/6 (PJW)
Tobacco Fertiliser	90	do.	do. do. do.	....	3·50	....	....	10·25	1·50	2·00	13·75	10·00	....	£28/4/0 (GW)
Tomato Manure	92	do.	do. do. do.	....	2·50	....	....	13·25	2·25	2·50	18·00	....	5·00	£21/9/6 (AW)
Potato Manure "A"	109	A in diamond	Albany SuperphosphateCo. Pty. Ltd.	....										

Potato Manure "B"	110	do.	do.	do.	do.	....	3·50	....	....	12·50	2·00	2·25	16·75	....	5·00	£22/17/3 (AW)
Potato Manure "E"	112	do.	do.	do.	do.	....	3·50	....	....	11·50	2·00	2·00	15·50	....	8·00	£24/5/9 (AW)
Orchard Manure	113	do.	do.	do.	do.	....	3·50	....	..	12·50	2·00	2·25	16·75	..	5·00	£22/17/3 (AW)
Garden Fertiliser	114	do.	do.	do.	do.	....	3·50	....	..	11·50	2·00	2·00	15·50	..	8·00	£24/5/9 (AW)
Bulb-o	120	Blue Cross	Agricultural Products Co.			2·25			3·00	3·50	3·50	10·00		4·50	Packets	
Special Garden Fertiliser	130	do.	do.	do.	do.	4·00			3·00	3·00	6·00	12·00	2·50	....	Packets	
Potato Manure "E"	134	do.	do.	do.	do.	3·50	....	....	11·50	1·25	2·75	15·50		8·00	Packets	
Potato Manure "A"	136	do.	do.	do.	do.	2·50			13·25	2·25	2·50	18·00		5·00	Packets	
Potato Manure "E"	141	Jumbo Product	H. & J. Agricultural & Chemical Products Co.			3·50			11·50	1·25	2·75	15·50		8·00	Packets	
Potato Manure "E"	157	David Gray's	David Gray & Co. Ltd.			3·50			11·50	2·00	2·00	15·50		8·00	Packets	
Superhumus No. 1	172	Dawn	Dawn Fertilisers			2·00			1·80	0·50	0·20	2·50		2·00	Packets	
Superhumus No. 2	173	do.	do. do.			4·00			3·00	0·50	6·50	10·00		0·50	Packets	
Rose Fertiliser	182	Symonds	E. Symonds			4·25			4·00	3·50	4·50	12·00		3·75	Packets	
Lawn Fertiliser	183	do.	do.			4·25	....		4·00	3·50	4·50	12·00		3·75	Packets	
Potato Manure "E"	185	do.	do.			3·50	....		11·50	2·00	2·00	15·50		8·00	Packets	
Potato Manure "B"	186	do.	do.			3·50	....	....	12·50	2·00	2·25	16·75		5·00	Packets	
Complete Plant Food	194	Fosterite	H. S. Emerson			4·40			1·00	2·00	6·00	9·00	3·00 (Muriate and Sulphate)		£57 (PW)	
Potato Manure "E"	198	Best	William J. Pasco & Sons			3·50			11·50	2·00	2·00	15·50		8·00	Packets	
Potato Manure "A"	199	do.	do. do. do.			2·50			13·25	2·25	2·50	18·00		5·00	Packets	
Nitrophoska Red	206	B.A.S.F.	Henry H. York & Co. Pty. Ltd.	5·70	7·30				5·40	7·60		13·00	18·10 (As nitrate)	1·90	£59/10/0 (P)	
Nitrophoska Blue	207	do.	do. do. do.	5·30	6·70				5·00	7·00		12·00	10·10 (As nitrate)	8·90	£59/10/0 (P)	
Bumper Crop	209	Lanes	Lanes (W.A.) Pty. Ltd.	6·50	6·50				5·20	7·80		13·00		20·00	£59/10/0 (P)	
Nitrophoska Grey	214	B.A.S.F.	Henry H. York & Co. Pty. Ltd.	5·30	6·20				3·00	5·50		8·50		17·00	£59/10/0 (P)	
Nitrophoska Yellow	215	do.	do. do. do.	6·60	8·40				6·60	8·40		15·0	0·90	11·10 (As nitrate)	£59/10/0 (P)	
Nitrophoska Green	216	do.	do. do. do.	6·60	8·40				6·60	8·40		15·0		15·00	£59/10/0 (P)	
6. Phosphoric Anhydride and Potash.																
Super and Potash No. 1	20	Cresco	Cresco Fertilisers (W.A.) Ltd.						14·00	2·50	2·50	19·00		9·00	£18/9/0 (PW)	
Super and Potash	50	Sickle	Cuming Smith Mount Lyell						14·00	2·50	2·50	19·00		9·00	£18/9/0 (PW)	
Do.	63	Mount Lyell	do. do. do.						14·00	2·50	2·50	19·00		9·00	£18/9/0 (PW)	
Do.	81	C.S.M.L.	do. do. do.						14·00	2·50	2·50	19·00		9·00	£18/14/0 (PJW)	
Do.	108	A in diamond	Albany Superphosphate Co.						14·00	2·50	2·50	19·00		9·00	£18 19 3 (AW)	
7. Phosphoric Anhydride and Minor Elements.																
Super and Copper Ore	13	Cresco	Cresco Fertilisers (W.A.) Ltd.		(Cu) 1·25				13·00	2·25	3·75	19·00			£17/6/0 (PW)	
Super and Manganese	14	do.	do. do. do.		(Mn) 3·80				14·50	2·50	2·50	19·50			£26/4/6 (PW)	
Super and Zinc Oxide	15	do.	do. do. do.		(Zn) 1·15				16·50	2·75	3·25	22·50			£15/12/0 (PW)	
Super and Molybdenum	16	do.	do. do. do.	(2 ozs. Molybdenum Oxide per bag)					17·00	3·00	3·00	23·00			£15 14 6 (PW)	
Super and Cobalt	17	do.	do. do. do.	(5 lb. Cobalt Sulphate per ton)					17·00	3·00	3·00	23·00			£16 15 6 (PW)	
Super, Copper Ore and Zinc Oxide	18	do.	do. do. do.		(Cu) 1·25	(Zn) 1·15			12·75	2·25	3·50	18·50			£18 9 3 (PW)	
Super, Copper, Zinc and Molybdenum	19	do.	do. do. do.		(Cu) 1·25	(Zn) 1·15	(Mo) 2 oz. per bag		12·75	2·25	3·50	18·50			£19/15/4 (PW)	
Super and Minor Elements	21	do.	do. do. do.	....	(Cu) 1·00	(Zn) 2·25	(Mn) 2·25		11·75	2·50	2·25	16·50			£26/6/2 (PW)	
Super and Copper Sulphate	27	do.	do. do. do.		(Cu) 1·25				16·00	2·75	2·75	21·50			£21/15/0 (PW)	

(PW) Perth Works (GW) Geraldton Works (BW) Bunbury Works (PJW) Picton Junction Works (AW) Albany Works

FERTILISERS—continued.

Name of Fertiliser	Reg. No.	Registered Brand	By Whom Registered	Nitrogen (N) as				Phosphoric Anhyride (P_2O_5) as				Potash (K_2O) as		Cash Price per ton at Works (W) or on Rails at Perth (P)
				Nitrate	Ammonia	Blood and Bone	Bone Dust	Water Soluble	Citrate Soluble	Acid Soluble	Total	Sulphate	Muriate	
				%	%	%	%	%	%	%	%	%	%	
Super, Copper, Zinc and Cobalt	28	Cresco	Cresco Fertilisers (W.A.)	5 lb. Cobalt Sulphate per ton	(Cu) 1·25	(Zn) 1·15	..	12·75	2·25	3·50	18·50	..	....	£20/16/3 (PW)
Super and Copper Ore	42	Sickle	Cuming Smith Mount Lyell	....	(Cu) 1·25	....	..	13·00	2·25	3·75	19·00	....	..	£17/6/0 (PW)
Super and Manganese	43	do.	do. do. do.	..	(Mn) 3·80	..	..	14·50	2·50	2·50	19·50	....	....	£26/4/6 (PW)
Super and Zinc	44	do. .	do. do. do.	..	..	(Zn) 1·15	....	16·50	2·75	3·25	22·50	....	....	£15/12/0 (PW)
Super and Molybdenum	45	do. ..	do. do. do.	(Mo) Trace	....	....	..	17·00	3·00	3·00	23·00	..	..	£15/14/6 (PW)
Super and Cobalt	46	do. ..	do. do. do.	(Co) Trace	....	....	....	17·00	3·00	3·00	23·00	....		£16/15/6 (PW)
Super, Copper Ore and Zinc	47	do.	do. do. do.	....	(Cu) 1·25	(Zn) 1·15	....	12·75	2·25	3·50	18·50	....	...	£18/9/3 (PW)
Super, Copper, Zinc and Cobalt	48	do.	do. do. do.	(Co) Trace	(Cu) 1·25	(Zn) 1·15	..	12·75	2·25	3·50	18·50	....	....	£20/16/3 (PW)
Super, Copper, Zinc and Molybdenum	49	do.	do. do. do.	(Mo) Trace	(Cu) 1·25	(Zn) 1·15	..	12·75	2·25	3·50	18·50	....	....	£19/15/3 (PW)
Super and Copper Ore	60	Mount Lyell	do. do. do.	....	(Cu) 1·25	....	....	13·00	2·25	3·75	19·00	.	....	£17/6/0 (PW)
Super and Zinc	61	do.	do. do. do.	..	....	(Zn) 1·15	..	16·50	2·75	3·25	22·50	....	..	£15/12/0 (PW)
Super, Copper Ore and Zinc	62	do.	do. do. do.	....	(Cu) 1·25	(Zn) 1·15	....	12·75	2·25	3·50	18·50	....	....	£18/9/3 (PW)
Super and Copper Ore	73	C.S.M.L.	do. do. do.	(Cu) 1·25	....	....	13·00	....	2·25	3·75	19·00	....	....	£17/6/0 (PJW) (GW)
Super and Manganese	74	do.	do. do. do.	(Mn) 3·80	....	....	....	14·50	2·50	2·50	19·50	....	....	£26/4/6 (PJW) (GW)
Super and Zinc	75	do.	do. do. do.	....	....	(Zn) 1·15	..	16·50	2·75	3·25	22·50	....	..	£15/12/0 (PJW) (GW)
Super and Molybdenum ..	76	do.	do. do. do.	(Mo) Trace	....	....	....	17·00	3·00	3·00	23·00	..	...	£15/14/6 (PJW) (GW)
Super and Cobalt	77	do.	do. do. do.	..	..	....	(Co) Trace	17·00	3·00	3·00	23·00	....	...	£16/15/6 (PJW) (GW)
Super, Copper Ore and Zinc	78	do.	do. do. do.	..	(Cu) 1·25	(Zn) 1·15	..	12·75	2·25	3·50	18·50	..	....	£18/9/3 (PJW) (GW)
Super, Copper, Zinc and Cobalt	79	do.	do. do. do.	....	(Cu) 1·25	(Zn) 1·15	(Co) Trace	12·75	2·25	3·50	18·50	....	..	£20/16/3 (PJW) (GW)
Super, Copper, Zinc and Molybdenum	80	do.	do. do. do.	(Mo) Trace	(Cu) 1·25	(Zn) 1·15	....	12·75	2·25	3·50	18·50	....	....	£19/15/3 (PJW) (GW)
Super and Copper Ore	100	A in diamond	Albany Superphosphate Co.	....	(Cu) 1·25	....	..	13·00	2·25	3·75	19·00	....	....	£17/6/0 (AW)
Super and Manganese	101	do.	do. do. do.	(Mn) 3·80	....	....	....	14·50	2·50	2·50	19·50	....	....	£26/4/6 (AW)
Super and Zinc	102	do.	do. do. do.	..	..	(Zn) 1·15	..	16·50	2·75	3·25	22·50	....	..	£15/12/0 (AW)
Super and Molybdenum	103	do.	do. do. do.	(Mo) Trace	..	..	..	17·00	3·00	3·00	23·00	..	....	£15/14/6 (AW)
Super and Cobalt	104	do.	do. do. do.	....	..	....	(Co) Trace	17·00	3·00	3·00	23·00	....	..	£16/15/6 (AW)
Super, Copper Ore and Zinc	105	do.	do. do. do.	....	(Cu) 1·25	(Zn) 1·15	....	12·75	2·25	3·50	18·50	....	....	£18/9/3 (AW)
Super, Copper, Zinc and Cobalt	106	do.	do. do. do.	....	(Cu) 1·25	(Zn) 1·15	(Co) Trace	12·75	2·25	3·50	18·50	....	....	£20/16/3 (AW)

Super, Copper, Zinc and Molybdenum	107	A in diamond	Albany Superphosphate Co.	(Mo) Trace	(Cu) 1·25	(Zn) 1·15	....	12·75	2·25	3·50	18·50	....	....	£19/15/3 (GW)
8.—Nitrogen Phosphoric Anhydride and Minor Elements.														
Hydrangea Blueing Tonic	122	Blue Cross	Agricultural Products Co.	(Fe) 3·50	(Sul) 8·90	(Zn) 2·00	2·00	(Al) 3·20	.		2·00		...	Packets
Lawn Manure	178	Dawn Fertilisers	Dawn Fertilisers ..	(Fe) Trace (Mg) Trace	5·75	(Mn) Trace (Cu) Trace	(Zn) Trace (B) Trace	8·75	2·00	1·75	12·50			Packets
Fe-Ro-Chelate	116	Blue Cross	Agricultural Products Co.	(Fe) 3·00	....	....	As Urea 15·00	.	.	.	.	. .	..	Packets
9. Nitrogen Phosphoric Anhydride Potash and Minor Elements.														
Special Lawn Manure	3	Evergreen	Voldemers Ertners		12·00	(Zn) 0·30	(Cu) 0·10	3·25	0·50	0·50	4·25	....	11·50	Packets
Rose Manure	8	Clarksons	Clarksons (W.A.) Pty. Ltd.	....	5·00	.	.	2·40	5·00	2·10	9·50		5·00	Packets
Fertiliser	9	do.	do. do. do.	.	5·00	....	....	2·40	5·00	2·10	9·50	..	5·00	Packets
Special Mixture " 363 "	31	Cresco ..	Cresco Fertiliser (W.A.) Ltd.	.	12·00	(Zn) 0·30	(Cu) 0·10	3·25	0·50	0·50	4·25	. .	11·50	£37/9/0 (PW)
Rose Food	35	Keogh's	Wilcox Moffin Ltd. ..	. ..	5·70	(CaO) 9·40	. .	7·50	. .	0·30	7·80	.	10·70	Packets
Daphne Mix	37	do.	do. do.	....	6·00	(CaO) 18·50	. .	14·00		0·60	14·60	. .	3·20	Packets
Tobacco Fertiliser No. 2	91	C.S.M.L. ...	Cuming Smith Mount Lyell	(Cu) Trace	3·00	(Zn) Trace	.	7·50	1·50	1·50	10·50	15·00	. .	£25/11/9 (PJW)
Citrus Manure	117	Blue Cross	Agricultural Products Co.	(Al) 250 PPM (Fe) 1000 PPM	(Cu) 250 PPM 5·00	(B) 35 PPM (Zn) 250 PPM	(Mo) 12 PPM (Mg) 750 PPM	(Mn) 550 PPM	5·00	4·00	9·00	3·00	. .	Packets
Boost Crop	118	do.	do. do. do.	(Fe) 320 PPM (Al) 90 PPM	4·40 (Cu) 90 PPM	(Zn) 90 PPM (B) 13 PPM	(Mg) 275 PPM (Mo) 4 PPM	1·00 (Mn) 200 PPM	2·00	6·00	9·00	3·00		Packets
Fertosol	121	do.	do. do. do.	As Urea 23·00 (Fe) 500 PPM	7·00 (Cu) 1000 PPM	(Zn) 100 PPM (B) 50 PPM	(Mn) 120 PPM (Mo) 50 PPM	16·00	. .	. ..	16·00	8·00		Packets
Cardex	123	do.	do. do. do.	(Fe) 0·50	(Cu) 0·40	5·00	(Mg) 0·50	(Zn) 0·60	2·00	(Al) 0·40	2·00		2·50	Packets
Rose Bush Fertiliser	131	do.	do. do. do.	(Fe) 160 PPM (Al) 45 PPM	4·00 (Cu) 45 PPM	(Zn) 45 PPM (B) 6 PPM (Mo) 2 PPM	(Mg) 145 PPM (Mn) 100 PPM	2·00	2·00	4·00	8·00	3·00	.	Packets
Lawn Manure	132	do.	do. do. do.	(Fe) 160 PPM (Al) 45 PPM	4·00 (Cu) 45 PPM	(Zn) 45 PPM (B) 6 PPM (Mo) 2 PPM	(Mg) 145 PPM (Mn) 100 PPM	1·00	1·00	6·00	8·00	2·00	.	Packets
Rose Manure	151	David Gray's	David Gray & Co. Ltd. .	(Fe) 0·05 (Mo) 0·05	(Cu) 0·05 (B) 0·05	5·00 (Zn) 0·05	(Mg) 0·05 (Mn) 0·05	2·40 (Ca) 3·25	5·00	2·10	9·50	...	5·00	Packets
Citrus Manure	152	do.	do. do. do.	(Fe) 0·05 (Mo) 0·05	(Cu) 0·05 (B) 0·05	5·00 (Zn) 0·05	(Mg) 0·05 (Mn) 0·05	2·40 (Ca) 3·25	5·00	2·10	9·50	...	5·00	Packets

(PW) Perth Works (GW) Geraldton Works (BW) Bunbury Works (PJW) Picton Junction Works (AW) Albany Works

FERTILISERS—continued.

Name of Fertiliser	Reg. No.	Registered Brand	By Whom Registered	Nitrogen (N) as				Phosphoric Anhyride (P_2O_5) as				Potash (K_2O) as		Cash Price per ton at Works (W) or on Rails at Perth (P)
				Nitrate	Ammonia	Blood and Bone	Bone Dust	Water Soluble	Citrate Soluble	Acid Soluble	Total	Sulphate	Muriate	
				%	%	%	%	%	%	%	%	%	%	
Lawn Fertiliser	153	David Gray's	David Gray & Co. Ltd.	(Fe) 0·05 (Mo) 0·05	(Cu) 0·05 (B) 0·05	5·00 (Zn) 0·05	(Mg) 0·05 (Mo) 0·05	2·40 (Ca) 3·25	5·00	2·10	9·50	....	5·00	Packets
Special Garden Fertiliser	154	do.	do. do. do.	(Fe) 0·05 (Mo) 0·05	(Cu) 0·05 (B) 0·05	5·00 (Zn) 0·05	(Mg) 0·05 (Mo) 0·05	2·40 (Ca) 3·25	5·00	2·10	9·50		5·00	Packets
Seedling Manure	170	Dawn	Dawn Fertilisers	(Fe) Trace	5·30 (Cu) Trace	(Zn) Trace (B) Trace	(Mg) Trace (Mn) Trace	8·75 Plus	1·25 Methaldehyde	1·00	11·00	....	4·40	Packets
Bulb and Corm Manure	171	do.	do. do.	(Fe) Trace	1·90 (Cu) Trace	(Zn) Trace (B) Trace	(Mg) Trace (Mn) Trace	9·20 Plus	1·40 Methaldehyde	0·80	11·40	....	9·00	Packets
Plant Food	174	do.	do. do.	(Fe) Trace	5·30 (Cu) Trace	(Zn) Trace (B) Trace	(Mg) Trace (Mn) Trace	7·85 Plus	1·15 Methaldehyde	2·00	11·00	..	3·50	Packets
Rose Manure	179	do.	do. do.	(Fe) Trace	5·25 (Cu) Trace	(Zn) Trace (B) Trace	(Mg) Trace (Mn) Trace	7·75 Plus	1·25 Methaldehyde	2·00	11·00	..	3·25	Packets
Lawn Food	191	Walco	Canning Lawn Service	....	12·00	(Cu) 0·112	(Zn) 0·36	3·30	0·70	0·50	4·50	....	11·50	Packets
Vigoro Plant Food	202	Dawsons	Dawsons Harrison Pty. Ltd.	(CaO) 17·60	6·04	(Cu) 0·40	(Zn) 0·65	2·68	2·26	8·76	13·70	5·85	....	£45 (PW)
Lawn Food	203	do.	do. do. do.	....	11·50	(Cu) 0·40	(Zn) 0·65	4·75	0·75	0·75	6·25	6·50	....	£33/10/4 (PW)
Rose Food	205	do.	do. do. do.	(CaO) 17·60	6·04	(Cu) 0·40	(Zn) 0·65	2·68	2·26	8·76	13·70	5·85	....	£45 (PW)
Liquid Manure	208	Aquasol	Horticultural Industries	(CaO) 1·00	(Mg) 0·30	As Urea 20·00	....	12·00	....	..	12·00	16·00	..	£196 (P)
Floragro Water Soluble Liquid Manure	210	Lanes	Lanes (W.A.) Pty. Ltd.	(Fe) Trace (Mg) Trace	(Mn) Trace (B) Trace	(Mo) Trace (Cu) Trace	(Zn) Trace As Urea 24·00	12·00	....	..	12·00	....	16·00	Packets
Liquid Manure	213	Watkins	The J. R. Watkins Co.	(Fe) Trace (B) Trace	(Cu) Trace (Mn) Trace	(Zn) Trace (Mo) Trace	As Urea 22·00	12·00	....	....	12·00	14·00	....	Packets
10. Liquid Fertilisers.														
Liquid Manure	36	Keogh's ..	Wilcox Mofflin Ltd.	(CaO) 1·25	1·70	..	..	3·70	0·10	....	3·80	..	2·00	Bottles
Liquid Fertiliser	133	Blue Cross	Agricultural Products Co.	....	....	....	As Urea 6·50	5·00	....	....	5·00	As Nitrate 3·00	....	Bottles
Concentrated Fertiliser	150	Spring	F. H. Faulding & Co. Ltd.	....	7·50	....	....	5·00	....	....	5·00	(As Nitrate 4·00	..	Bottles
Liquid Fertiliser and Plant Food	211	Lanes	Lanes (W.A.) Pty. Ltd.	(Mn) 0·25 (Mg) 0·20	(Fe) 0·40 (Cu) 0·25	(Zn) 0·12 (B) 0·50	As Urea 8·6	8·6	(Mo) 0·077 (So. Salts) 0·065	....	8·6	4·0	...	Bottles and Drums

Liquid Fertiliser	220	David Gray's	David Gray & Co. Ltd.	.	9·00	.	..	13·10	...	....	13·10	(As nitrate) 4·00	.	Bottles
11. Trace Elements.														
Minorels	125	Blue Cross	Agricultural Products Co.	(CaO) 9·00	(Fe) 4·00	(Zn) 1·00	(Mg) 3·30	(Mn) 2·25	(Al) 1·00	(Cu) 1·00	(B) 0·15	(Mo) 0·05	.	Packets
Tracels	175	Dawn	Dawn Fertiliser		(Fe) 37·60	(Zn) 0·20	(Mg) 2·50	(Mn) 2·00	.	(Cu) 0·90	(B) 0·50		. .	Packets
Trace Elements	195	Fosterite	H. S. Emmerson	(CaO) 9·00	(Fe) 4·00	(Zn) 1·00	(Mg) 3·30	(Mn) 2·25	(Al) 1·00	(Cu) 1·00	(B) 0·15	(Mo) 0·50		£117/14/5 (PW)
B.—ORGANIC FERTILISER														
1. Blood and Bone.														
Blood and Bone ...	6	Evergreen	Voldemars Ertners .		.	5·00			2·00	7·15	9·15			Packets
do. do.	7	A.J.B.	A. J. Bush & Sons (Manu.) Pty. Ltd.			5·00			10·50	3·50	14·00			£36/0/0 (W)
do. do.	10	Eclipse	West Australian Meat Export Works	...	.	6·00	...	.	3·00	9·00	12·00	.		£31/0/0 (W)
Blood and Bone Manure	32	Kitchens	J. Kitchen & Son Pty. Ltd.	...	.	6·80		...	9·00	5·00	11·00	....	.	£30/0/0 F.O.B. Melbourne
Blood and Bone Fertiliser	33	Sayer	Burridge & Warren Pty. Ltd.	....	...	4·25	....	.	8·85	9·90	18·75	....		£46/10/0 (P)
Blood and Bone	34	Wyndham	Wyndham Meatworks	....	.	6·00	.	..	5·50	9·50	15·00	.	. .	£35/0/0 (P)
do. do.	128	Blue Cross	Agricultural Products Co.	...	..	5·00	.	.	3·00	9·00	12·00	.		Packets
Fertiliser Blood and Bone	140	Jumbo Product	H. J. Agricultural & Chemical Products Co.	. .	.	5·00	.	....	2·00	8·00	10·00		.	Packets
do. do.	144	Sound ...	Cockburn Sound Fertilisers	.	. .	5·25	. .	.	2·50	6·50	9·00			£32 (W)
do. do.	155	David Gray's	David Gray & Co. Ltd.	.	. .	5·00	.		2·00	8·00	10·00		.	£34 (W)
do. do.	169	Smorgon	W. Thomas & Co. (W.A.) Ltd.	..	..	5·00	...	...	4·00	10·00	14·00		. .	£40 (W)
do. do.	177	Dawn ...	Dawn Fertilisers	. ..	. .	5·00	....	.	2·00	8·00	10·00		.	Packets
do. do.	181	Symonds	E. Symonds	.		5·25		.	2·50	6·50	9·00		. .	Packets
do. do.	192	T. B. & S. in diamond	Thomas Borthwick & Sons	.	....	5·75	.	.	6·75	5·25	12·00		.	£40 (AW)
do. do.	201	Best	William J. Pascoe & Sons	.	.	6·00	. .	.	4·00	11·00	15·00			Packets
do. do.	166	Wesfarmers	Westralian Farmers Co-op. Ltd.	....		5·00			2·00	7·15	9 15		..	£30 (P)
2. Animal Fertilisers.														
Animal Fertilisers	129	Blue Cross	Agricultural Products Co.	....		3·50	.		3·00	9·00	12·00		.	Packets
Meat Meal Fertilisers	204	Dawsons	Dawson Harrison Pty. Ltd.	(CaO) 14·50		4·59		0·14	6·56	9·60	16·30		.	£32/10/0 (W)
3. Blood Meal Fertilisers.														
Dried Blood	167	Wesfarmers	Westralian Farmers Co-op. Ltd.	..		12·00			. .	.	.		.	£80 (P)
4. Fish Fertilisers.														
Special Fish Manure	115	Blue Cross	Agricultural Products Co.	....	.	(Crayfish and Bones) 3·50				.	7·50			Packets
Fish Fertiliser	146	Sound	Cockburn Sound Fertilisers	....	. .	(Fish Offal and Bones) 4·50			2·00	6·00	8·00		.	£28 (W)
Fish and Bone Manure....	156	David Gray's	David Gray & Co. Ltd.	....	....	4·00			3·00	4·00	7·00		..	£2/8/0 per cwt.
5. Whale Fertilisers.														
Whale Fertiliser	137	Wrights ...	Wrights Ltd.	(Ca) 11·00	. .	7·50	.	.	.	.	12·00			£49/10/0 (AW) £54 (P)
C.—AGRICULTURAL LIME.														
Hydrated Lime	38	Swan	Swan Portland Cement Ltd.	Neutralising Value 93%										£13 (W) £13/10/0 (P)
Garden Lime	124	Blue Cross	Agricultural Products Co.	40% Calcium Carbonate Neutralising Value 75%										Packets
Garden Lime	142	Jumbo Product	H. J. Agricultural & Chemical Products Co.	Neutralising Value 75%										Packets
do. do.	165	David Gray's	David Gray & Co. Ltd.	Neutralising Value 75%										Packets
do. do.	176	Dawn . .	Dawn Fertilisers	Neutralising Value 75%										Packets
Lime Carbonate (A. Lime)	193	W.A. Minerals Ltd.	W.A. Minerals Pty. Ltd.	Neutralising Value 80%										£3/10/0 (W)
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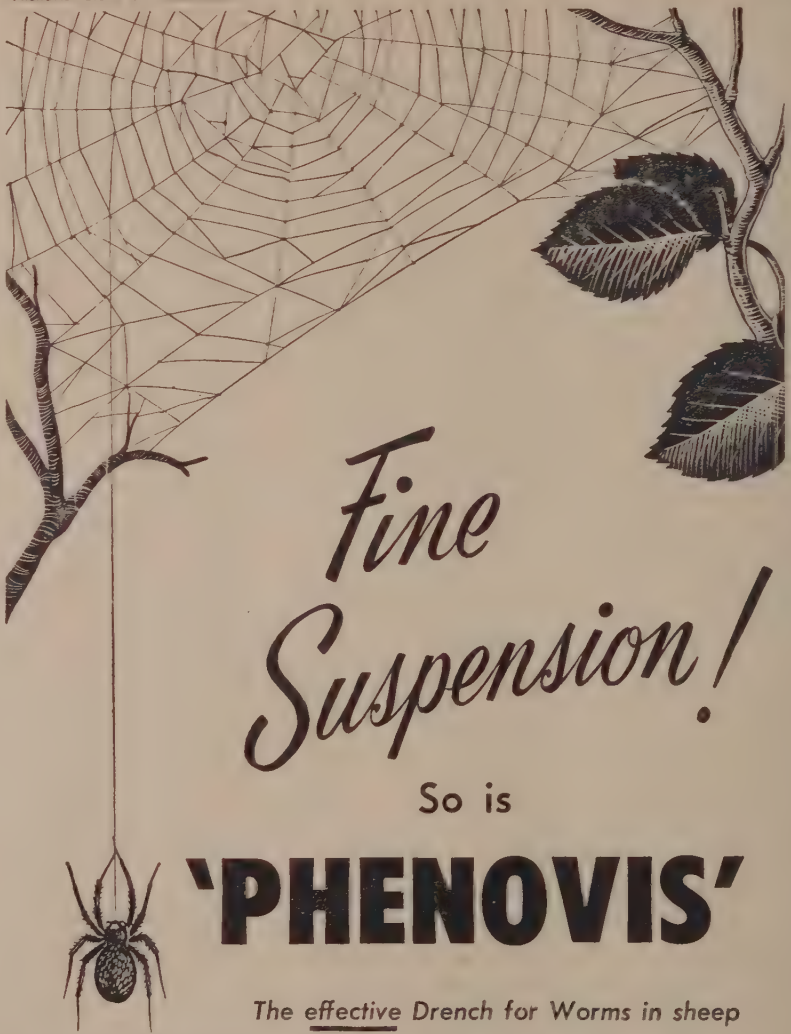

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Fig. 1.—Showing the dense mass of lush green material at the time of ploughing-in

SUNFLOWERS AS A COVER CROP FOR MARKET GARDENS

By M. HARDIE, Vegetable Instructor, Department of Agriculture

THE quantity of organic manure available to vegetable growers seems to decrease each year and it has therefore been necessary to seek other means of maintaining both soil fertility and the supply of humus which are essential for growing quality vegetables. This is doubly necessary in Western Australia since most of the vegetables are grown in close proximity to the metropolitan area where the soil is of a sandy nature and relatively infertile.

The planting of a cover crop is therefore becoming more popular with vegetable growers and would probably be practised to an even greater extent if the size of the garden permitted it. To grow vegetable crops all the year round in a market garden of limited size it is necessary for crops to follow each other in rapid succession, leaving insufficient time between crops for growing a cover crop. Many of our market gardens come into this category, having less than five acres under sprinklers. This has led inevitably to a loss of fertility and a consequent deterioration in the quality of the vegetables produced in some gardens.

With such crops as lupins, tick-beans, oats and other plants available it has not been difficult to find a cover crop suitable for growing in the period of the year from mid-autumn to mid-spring; but it has always been a problem to find a crop which would grow quickly and well in the summer months without being a breeding-ground for pests.

Some of the qualities sought for in a cover crop may be listed as follows:—

(1) It should grow quickly and produce plenty of bulk for turning in.

(2) The growth should be soft and should rot down quickly.

(3) It should not be a harbour for pests or diseases, and should be capable of overcoming competition from weeds.

(4) The cost of seed per acre must be reasonable and preferably it should lend itself to production on the property where necessary.

Mr. L. Goodchild, a market gardener in the Spearwood district, grew a cover crop

Fig. 2.—A close-up, showing the thick growth of stalks and leaves

this summer which appeared to meet all these requirements. Following the suggestion of a local seedsman, he planted early in February an area of his garden with sunflower seeds. (*Helianthus annuus.*)

Five weeks after planting, at which stage they were still growing vigorously, the plants had reached an average height of five feet and had just started to form flower buds. The growth was dense and even and constituted a good bulk of lush, green material. Had they been left longer, they would have grown considerably more but it was considered that the plants were at a proper stage for ploughing in and it was intended to plant a crop of runner beans in the area.

Although weeds such as nightshade (*Solanum nigrum*), never-die (*Portulaca oleracea*), stinging nettle (*Urtica urens*), potato weed (*Galinsoga parviflora*) had germinated with the sunflowers they were unable to compete with the more vigorous growth of the latter and were soon smothered.

As the area had been manured for growing vegetables previously, no fertiliser was required to grow this crop. Water was applied through the sprinkler system for half an hour each day for the first four weeks and for three-quarters of an hour for the remaining period of growth. Temperatures for most of the growing period were higher than normal.

In spite of the fact that there were plenty of red spider infesting the crops in the garden, the sunflowers were practically free from this pest and were unaffected by any other disease or pest.

The seed for this crop cost 1s. 9d. per lb. and was sown at the rate of approximately 27 lb. to the acre, which was heavy enough to give a good, thick stand of plants. If it is considered that this is too costly, there is no reason why a few plants cannot be grown to produce seed for the following season. Under local conditions, sunflowers grow vigorously and each plant produces a large flower-head with good quality seed.

Vegetable growers whose gardens are limited in area may find in this crop the answer to the problem of maintaining soil fertility at the present time when supplies of organic manure are so limited.

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By T. D. Lysenko

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Fig. 1.—A fairly early case of pregnancy toxaemia. The animal appears dazed and wanders aimlessly paying little attention to anyone approaching

PREGNANCY TOXAEMIA OF EWES

By J. CRAIG, M.R.C.V.S., Senior Veterinary Officer

RECENT research has thrown new light on the essential nature of the disease of ewes known as pregnancy toxaemia. That it was basically a nutritional disease was well established, but it is now known to be primarily a brain disorder caused by a decrease in the quantity of blood sugar supplied to the brain.

The highly fatal metabolic disease has a world-wide distribution, occurring wherever sheep-raising is carried out, and has been known by a variety of names, the most common of which are "twin-lamb disease," pregnancy paralysis and pregnancy ketosis. British breeds and cross-breeds are possibly more likely to be affected than Merinos, due no doubt, to the higher twinning rate in the former.

In Western Australia, pregnancy toxaemia occurs most commonly throughout the agricultural areas, but is not likely to be so prevalent in the pastoral districts. The annual losses are extremely variable, and during some seasons such as the present one, where a long excessively dry summer was succeeded by a delay in the onset of autumn rains, mortalities may be widespread and severe. Not only must the loss of valuable flock ewes be considered, but the further potential value of unborn lambs and consequent lowered lambing percentages, must be taken into account. Thus, the overall economic loss involved makes pregnancy toxaemia one of the most important diseases of the sheep industry.

Losses from pregnancy toxaemia are almost wholly confined to the fifth (last) month of pregnancy, but the disease may appear as early as six weeks before the due date of lambing. It affects mature ewes mainly, particularly those carrying twins or triplets, hence the popular term "twin-lamb disease," but ewes carrying single large lambs may also develop symptoms of the disease.

CAUSE

The blood sugar (glucose) must be maintained at certain required levels in order to meet the normal metabolic requirements of the ewe; these energy

requirements are usually met by the carbohydrates and to a lesser extent, by the proteins and fats in the diet.

The blood sugar level of ewes that are heavy in lamb falls rapidly if they are starved or underfed, even for short periods. The resultant fall in blood sugar (hypoglycaemia) may be such that the amount of glucose reaching the brain via the blood stream may be insufficient to keep the nervous tissue functionally normal, and brain damage (encephalopathy) May, the available grazing steadily deteriorates both in quality and often in quantity; eventually it is quite incapable of maintaining in-lamb ewes at an adequate nutritional level.

The growth-rate of the developing foetus is especially rapid during the last month of pregnancy; consequently, the nutritional demands of the foetus upon the pregnant ewe are extremely high also, and this is increased by the added requirement of twins or triplets.

Fig. 2.—An advanced case in which the ewe is comatose

results. The higher nervous centres (cerebral cortex) of the brain which are responsible for preserving consciousness have the greatest sugar needs and are therefore the first to be affected. The symptoms seen in a ewe affected with pregnancy toxaemia can thus be related to the degree of the brain damage sustained, most of these symptoms being associated with depressed consciousness.

PREDISPOSING FACTORS

Under-nutrition and starvation are the main predisposing factors as far as pregnancy toxaemia is concerned.

Under Western Australian conditions, it is almost inevitable that ewes will suffer from under-nutrition during the latter half of pregnancy, unless measures are taken to prevent this by hand-feeding. In the majority of flocks, lambing will be timed to commence during May, this being preceded for the most part by a prolonged dry summer period. From October until

When pregnancy toxaemia appears among ewes which are apparently in good condition and are being hand-fed, it is likely that either the scale of hand-feeding is not sufficiently high, or that certain of the less aggressive ewes may not be getting a full share of their ration and are in reality, beginning to fall off in condition.

Other important predisposing factors include the forwarding of in-lamb ewes for long distances by rail, and prolonged yarding; in both instances, the period of enforced starvation may be such as to precipitate an outbreak of pregnancy toxaemia.

It is recognised that ewes, whether in fat or poor condition, may equally show symptoms of pregnancy toxaemia provided the necessary predisposing factors are present. However, the stress of a sudden check in the feeding level is likely to be more acute in the case of fat ewes which have been kept on a reasonably

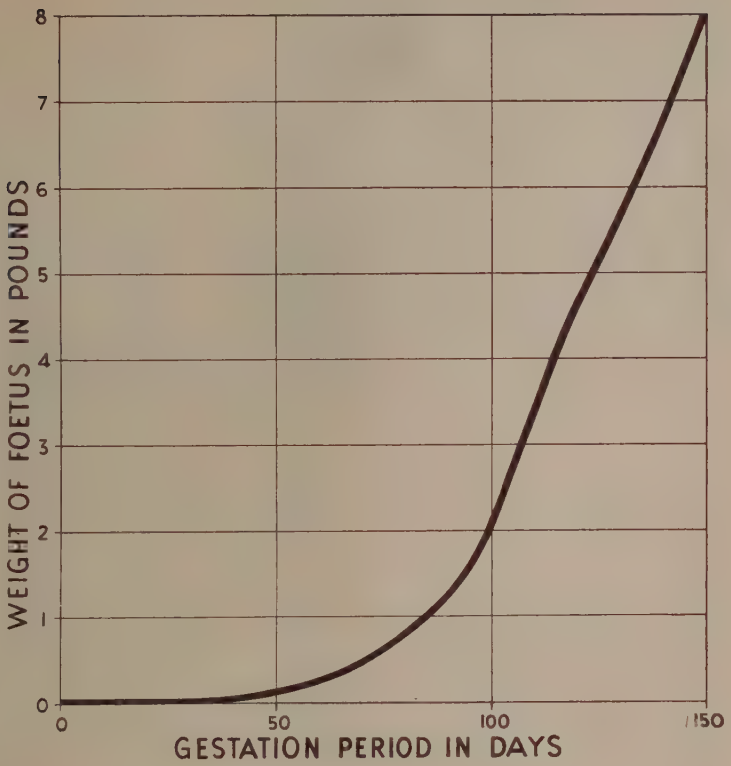

Fig. 3. — Graph showing growth rate of the unborn lamb (foetus). In the first 100 days of pregnancy, the foetus only makes one-quarter of its growth (2 lb.). During the next 50 days it makes most of its growth and increases to 8 lb. in weight. This rapid development imposes a severe strain on the ewe's metabolism.

high plane of nutrition, than with poor-conditioned ewes which have been maintained on a lower average standard of feeding.

SYMPTOMS

Early symptoms may be missed and merely include standing off from the flock and not feeding. Affected ewes appear dazed and move about in an aimless manner, seemingly quite oblivious of their surroundings. They pay little attention to anyone approaching near them, appearing to be blind and semi-conscious. Their appetite is completely lost; there is grinding of the teeth and sometimes a thick mucous discharge from the nostrils.

When driven, affected ewes commonly show a stiff unsteady gait; they may collapse after going a short distance and be unable to rise again without assistance. Finally, the ewe goes down and lies in a comatose condition, usually with her head turned to one side, until death takes place.

The temperature remains normal throughout the course of the disease, and affected ewes may linger up to a week from the first appearance of symptoms. Should lambing occur in the early stages of the disease, recovery is possible, but once the symptoms have become well advanced, recovery is unlikely. Ewes which have already lambed, do not of course, become affected with pregnancy toxaemia.

POST-MORTEM

The most characteristic post-mortem feature is seen in the liver, which is almost invariably enlarged and yellow in colour. This is due to fatty infiltration. Sometimes similar but less marked changes may occur in the kidneys which appear paler than normal. Commonly too, a white flecking of the abdominal and kidney fat is apparent. In many cases, twin lambs or triplets within three weeks of the due lambing date may be found.

Fig. 4.—A liver from a sheep suffering from advanced pregnancy toxaemia. Note light colour due to heavy infiltration with fat.

TREATMENT

In past years, varied treatments were used in an attempt to save ewes affected with this disease; however, the results obtained were invariably disappointing, and it was common to find 90 per cent. of ewes eventually dying once clinical symptoms become evident.

Recently, a satisfactory measure of success has attended the use of glycerine. This treatment aims to raise the blood sugar level to normal or above normal, and to maintain it at a high level for some time. Provided this treatment is carried out in the early stages of the disease when brain damage has not become too severe, then a reasonably high recovery rate may be expected.

The most effective means of keeping up the blood sugar level has been found to be by drenching with glycerine—4 oz. where Merinos are concerned, and 6 oz. in the case of British breed ewes—mixed with an equal volume of warm water, the glycerine being slowly absorbed and converted into glucose. This drench should be repeated each day until the symptoms disappear.

If treatment is commenced while the sheep is still able to stand, a high recovery rate may be expected; but if the ewe is down and unable to rise, it has usually been affected for several days and may have suffered irreparable damage to the brain. A better chance of recovery may be anticipated where the ewe is down in her normal breast position than lying on her side with legs outstretched. Gentle handling is essential during treatment, especially when drenching sheep that are down, since it is quite easy under these circumstances, for the drench to reach the lungs and cause pneumonia.

Ewes under treatment should be placed in a small sheltered yard or paddock with readily accessible feed and water. Once their appetite has returned, an adequate supply of easily digested carbohydrate such as the cereal grains, should be made available to help maintain the blood sugar at normal levels. By taking these precautions, recovered ewes will be less likely to suffer a relapse, such as might easily occur should they be immediately turned back into the same paddock as the rest of the ewe flock.

PREVENTION

It has been recognised for many years that the prevention of pregnancy toxaemia is a mater of good feeding and sound sheep husbandry practices.

Since under feeding in late pregnancy together with a resultant loss of condition is the principal predisposing factor, steps must be taken to prevent his happening. To ensure therefore, that ewes will at least maintain their condition during this period, hand feeding will be necessary on most properties. Obviously, the precise moment when supplementary feeding should commence will vary from property to property, depending on the quantity and quality of paddock feed available, but generally it should begin not later than eight weeks before the due lambing date.

During the last 50 days of pregnancy, the lamb in the uterus (womb) makes 75 per cent. of its total weight, while the ewe is also preparing for milk production for the occasion of the lamb's birth. The stress of these factors on the ewe is such that it can only be met by an adequate food intake.

The supplements available for hand feeding will generally be the grains and/or hay. It has been demonstrated that ewes will lamb satisfactorily when fed during the last eight weeks of pregnancy on a ration of ½ lb. of wheat grain per day, with some cereal hay in addition where paddock grazing has been poor. However, such a grain ration must be considered a minimum one, and a higher rate could be used with benefit, thus ensuring ample milk supplies and strong healthy lambs.

Up to 1 lb. of oats or 13 to 14 oz. of wheat or barley per head per day are suitable and recommended quantities. Where grain is unavailable, these rates may be replaced by 2 lb. daily of good quality meadow (clover) hay. Grain may be fed out in feeders or trickled out on a long thin line on the ground, and feeding twice or thrice weekly will give the best results by allowing the less vigorous ewes a better opportunity of obtaining their share of the feed.

It is well known that young greenfeed is especially valuable in the prevention of pregnancy toxaemia. The practice of providing early cereal crops of barley or oats, wherever practicable, is therefore recommended as being eminently suitable for ewes prior to lambing as well as for newly-lambed ewes.

The beneficial effect of exercise, where pregnancy toxaemia is concerned, is widely recognised, exercise of this nature appearing to have a stimulating effect on the blood sugar levels. Where the disease occurs on good feed and where there appears to be no obvious predisposing causes, driving for half an hour daily may be justified and is likely to give good results. Hand-fed sheep will be compelled to take exercise if the feed is distributed in a different part of the paddock on each occasion it is placed out.

Lastly, periods of sudden starvation during late pregnancy such as would result from trucking or yarding for unduly long periods, should be avoided.

SUMMARY

1. Pregnancy toxaemia occurs in in-lamb ewes in late pregnancy.

2. The main predisposing factor is under-nutrition which gives rise to very low blood sugar levels (hypoglycaemia) and resultant brain damage (encephalopathy).

3. Treatment of affected ewes by drenching daily with glycerine will give successful results, provided treatment is carried out in the early stages of the disease.

4. Prevention is a matter of maintaining adequate feeding levels in ewes, especially during the last two months of pregnancy.

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Timber.

The timber of karri is reddish-brown, closely resembling jarrah in appearance, although generally lighter in colour. Growth rings are not well defined and a wavy or striped figure due to interlocked grain is often shown. Karri can be distinguished from jarrah by the burnt splinter test, the former giving a white ash after burning, whereas jarrah burns slowly to a black char.

Karri is moderately heavy in weight, having a green density of 73 lb. per cubic foot, and when dried to 12% moisture content has a range from 49-62 lb. per cubic foot, with a mean density of 57.4 lb. per cubic foot, before reconditioning. In drying from the green condition to 12% moisture content the average shrinkage, before reconditioning of a backsawn board, is 10% (tangential shrinkage) and average shrinkage before reconditioning of a quartersawn board is 4.9% (radial shrinkage). Reconditioning only reduces these averages to 9.5% and 4.6%, respectively, showing that very little collapse takes place.

Seasoning.

Karri requires more care in seasoning than does jarrah, since it dries more slowly and has a much greater tendency to check. Occasionally fine ring checks occur as well as the usual ray checks. Thicknesses up to 2 inches can be kiln-dried from the green condition, but the considerable care required, the strict control of drying conditions, and the fairly long period required for drying would, in most cases, make this practice uneconomical. Good results may be obtained by partially air-drying prior to kiln-drying, particularly if protection and shielding of drying stacks is given during periods of warm and dry weather. The seasoning schedule used for jarrah is applied to karri.

Relatively slight collapse occurs, and reconditioning is not generally practised, but it provides the advantages of making the timber milder for dressing and giving slightly larger sizes. Approximately four weeks are required to kiln-dry 1 inch green stock.

Mechanical Properties.

Karri is both stiffer and tougher than jarrah and has been included in Strength Group "B" together with spotted gum and Sydney blue gum. At 12% moisture content karri has an average modulus of rupture of 20,600 lb./sq. in. compared with 15,900 lb./sq. in. for mountain ash and 14,800 lb./sq. in. for jarrah. In compression parallel to the grain karri has an average value of 10,500 lb./sq. in. compared with 9,700 lb./sq. in. for mountain ash at 12% moisture content. Karri is tougher than jarrah, having a toughness value when dry of 245 in. lb. compared with 110 in. lb. for jarrah.

General.

Karri, together with such timbers as blackbutt, southern blue gum, messmate, stringybark and red mahogany, is classified in durability class 3 and the sapwood is immune to Lyctus attack. It is fairly difficult to work and the grain has a tendency to rise; nevertheless with care it can be finished well and highly polished. It bends well at a radius of 6 inches after a minimum steaming period of one hour per inch thickness. Backsawn and quartersawn material have been found to bend equally well if free from checks, but selection requirements are more stringent with backsawn than with quartersawn stock. The bark of karri has a tannin content which varies from 11 to 22% and gives a leather of a good light colour. There are certain difficulties associated with the extraction process and these have been studied by the Division of Forest Products. The bark, if not dried soon after falling, undergoes a change which is not fully understood, whereby some of the tannins become insoluble. It was, however, found possible to obtain yields of 90-95% of the total tannin present by the use of sodium bisulphite in extraction. There seems to be a definite possibility in this material as a basis for tannin extraction since karri bark could be made available at large mills in sufficient quantities to justify the erection of extraction plants.

Uses.

This timber is well known overseas as well as in Australia for its valuable qualities. It is popular for superstructures because of its great strength, its availability in large sizes and long lengths, and its comparative freedom from defects. It is widely used in wharf and bridge structures.

In railway workshops it is used for wagon, van and carriage construction. It is largely used in agricultural implements, especially for bent parts. It is also used in shipbuilding and as mine lift guides in South Africa, and for crossarms in Great Britain. In dwellings it is used for rafters, studs, joists, flooring, interior trim for furniture. It is used largely in Western Australia for export apple cases and when treated, for wooden pipe lines. It can be rotary cut or sliced to provide a very good veneer and plywood, and these products are available commercially. Tests at the Division of Forest Products have shown that karri glues satisfactorily with casein, urea and tego resin film glues. Sleepers treated with preservative, have been found eminently suitable when used in dry climates.

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BONUSES FOR VERMIN CONTROL

(A paper presented at the Interstate Conference on Vermin Control held in Perth, March, 1957)

By A. R. TOMLINSON, Chief Vermin Control Officer

WHILE animal and bird pest control authorities and experts throughout the world condemn bonus systems, bonuses not only receive tremendous support from the graziers and farmers directly affected by the pests, but they are still being widely backed and used by local and government authorities. In Australia today bonuses are being paid in all States (possibly excluding Tasmania) and in some cases are regarded by the primary producers and authorities as a major control measure

So strongly do responsible bodies such as the Graziers' Federal Council advocate the continuation and even extension of bonus payments to control wild dogs and other pests that it is high time a conference such as this should study the system. It may be possible to present those concerned—particularly State and Commonwealth Government Departments and primary producer organisations—with some important facts on the subject.

Possibly the best way to do this would be to consider why bonuses are paid, arguments advanced in their favour and against them and any other relevant points.

WHY BONUSES ARE PAID

It will be agreed that bonuses are intended as an inducement or incentive for people to destroy pests. They may be paid on certain specific individual "killers" or as a uniform payment for the destruction of every one of the pests throughout a district.

The payments constitute reimbursement of expenditure on destruction measures by those directly affected by the pests (such as station owners destroying wild dogs attacking their sheep) and this will have some importance with landholders along the outer fringes who may possibly be protecting those further within settlement.

However their greatest importance in the eyes of the farmers and pastoralists would be to induce those not so directly involved to destroy the pests. This would include farm or station hands and professional or part-time hunters.

ARGUMENTS IN FAVOUR OF BONUSES

The supporters of bonus payments claim that—

(i) They assist farmers and pastoralists in their battle against vermin by meeting part of the costs.

(ii) They are an incentive to employees to carry out more destruction work than they normally would do.

(iii) They also induce many other people who would not normally be interested to become part-time destroyers, such as hunting parties from towns.

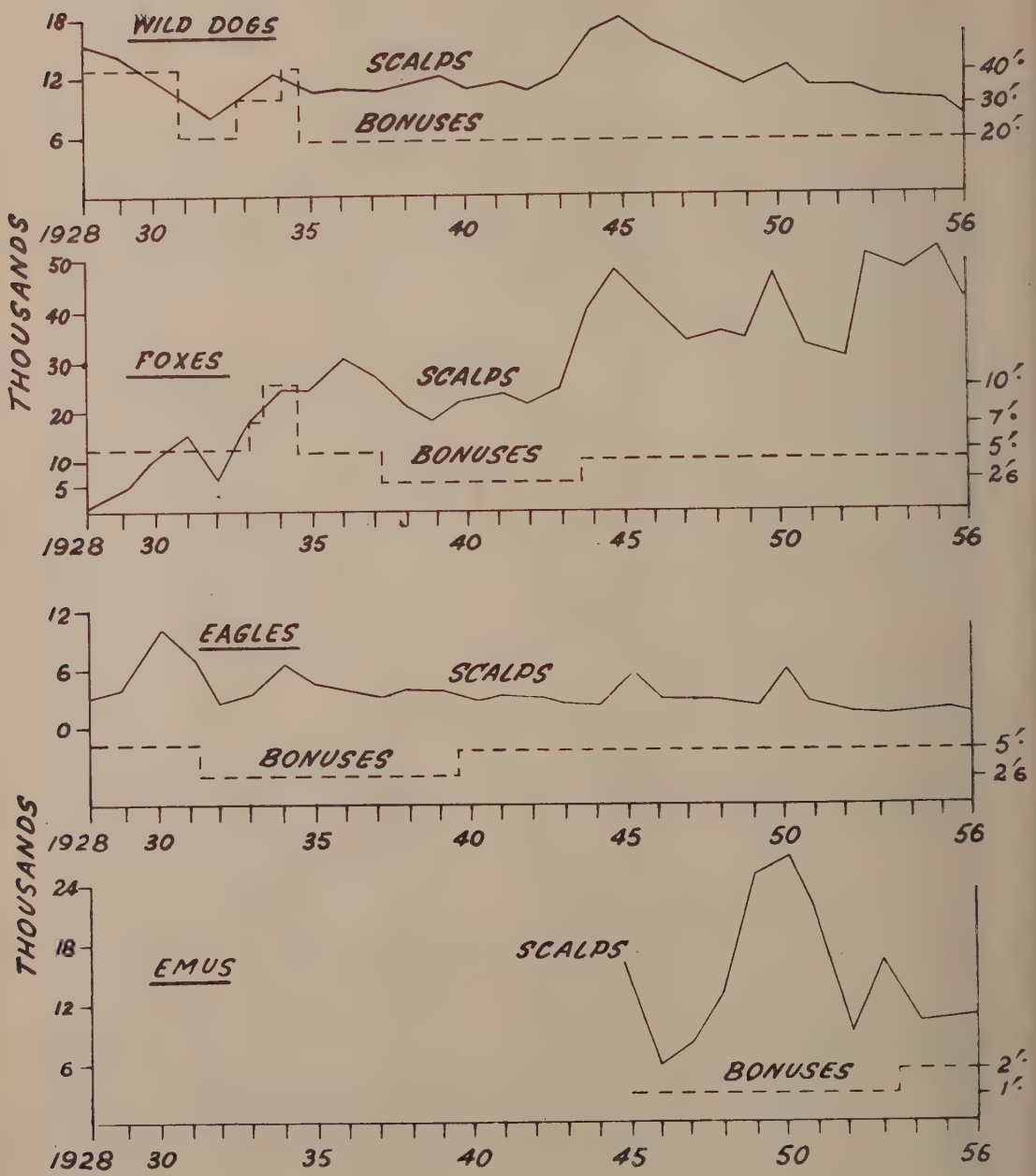
(iv) When offered for an individual "killer" at a high rate, they attract the most skilled persons.

(v) Scalps received are concrete evidence of destruction which indicates that employees are actually carrying out destruction work. In any case, every scalp produced is proof of one pest less.

(vi) In the absence of any better control work, bonuses are better than nothing.

BONUSES

RELATIONSHIP BETWEEN RATES PAID & NUMBER OF SCALPS RECEIVED ANNUALLY.



ARGUMENTS AGAINST BONUSES

Those against bonus payments contend that—

(i) There is a very strong tendency for bonuses to become regarded as the actual destruction method, instead as an inducement for others to assist. As a result, many farmers and pastoralists who should be the most active, consider that the bonuses have induced "other people" to deal with the problem, and so they may relax their own efforts. If the vermin become worse then the solution is to raise the bonus, and these "other people" will become more active.

(ii) Any bonus payment system is an open target for fraud, misrepresentation and exploitation. There are innumerable examples of these dishonest practices such as "farming" the pests, trafficking scalps from district to district, false claims, fraudulent practices in disposing of scalps after payments have been made.

(iii) The commercialising of any pest is normally opposed to effective control. For instance, it may be necessary to destroy over 80 per cent. of an animal population to offset the breeding rate. In most cases, long before 80 per cent. of the population was killed, destruction would not be economic as far as bonus hunters are concerned. Once the bulk of the population is destroyed, and possibly while at least 50 per cent. are left, the bonus hunters would move to more lucrative fields leaving the situation virtually unchanged, as far as lasting or permanent relief is concerned.

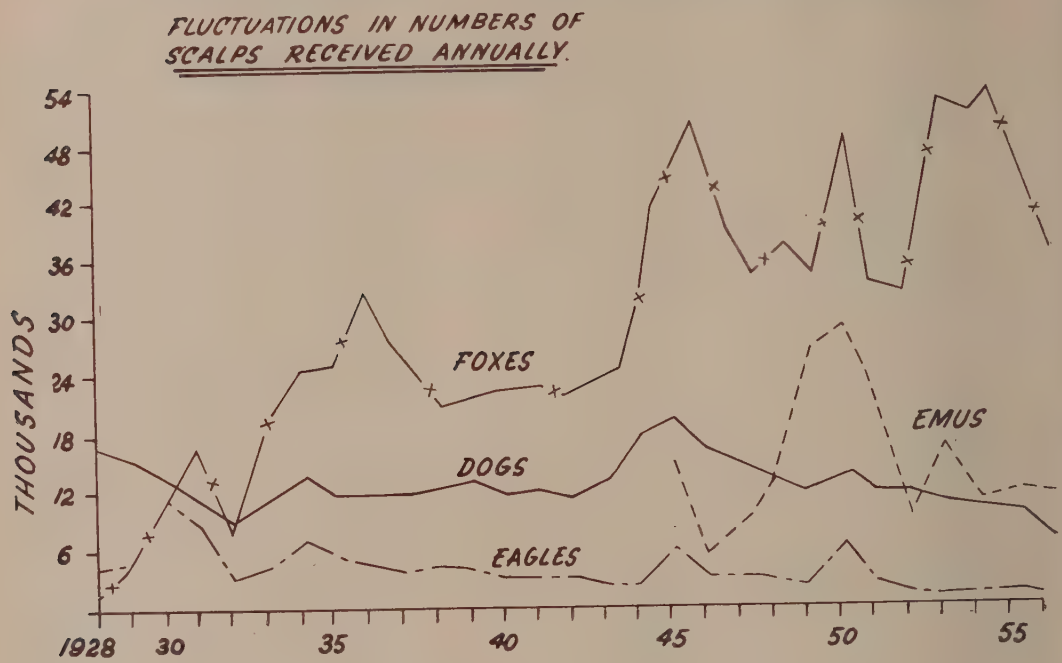
(iv) The higher the bonus, the more it pays the hunters to concentrate on individual pests instead of any mass destruction technique. Individual scalps become too valuable to take any risks of their being lost. This may be considered an advantage with "killers" but in practice it has meant that sources of infestation such as breeding grounds are neglected while everyone concentrates on a few pests. This will have disastrous results in the long run. An example of this is the decided preference for trapping over poisoning when bonus hunters operate. Owing to the relatively limited area which may be covered by traps, baiting would no doubt be more effective, but as the poisoned animals may move away after taking the baits, and not found, the chances of obtaining the scalps are greatly reduced.

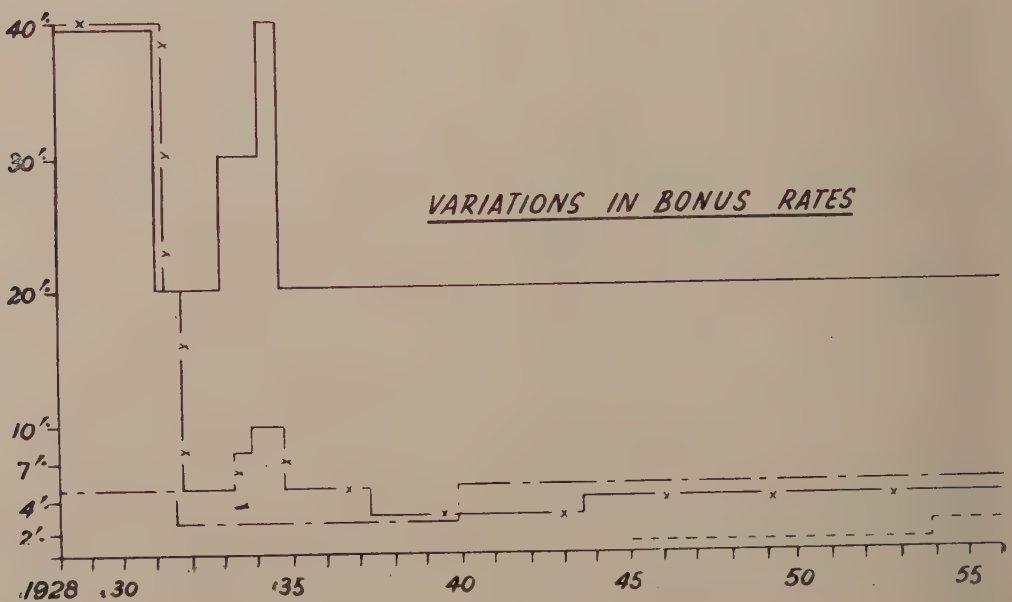
In this manner, the payment of a bonus, especially at a high rate, can and actually does, reduce the number of animals destroyed.

(v) Overseas experience over many years has proved the failure of bonuses. Every publication which mentions bonuses contains some indictment of the system, and extracts would occupy pages. In two American publications are some statements which appear to sum up the situation after the 300 years' experience in the United States with bonus payments. Young and Jackson (1951) said "State Game Departments and conservationists in general have almost unanimously concluded that the bounty system is not satisfactory as a method of controlling predatory animals." T. D. Scott (1955) stated "The bounty system has been carefully reviewed and found wanting by a number of workers in recent years. (Page 8.) Fraud takes many forms in a bounty system and, undoubtedly there are some techniques that are as yet not generally appreciated, for example, in Michigan the number of foxes bountied declined sharply when a law which designated township clerks as certifying agents for bounty payments was changed in the Fall of 1951 to assign this responsibility to conservation officers." (Page 9.) "In

BONUSES

COMPOSITE GRAPHS OF SCALP NUMBERS & BONUS RATES





areas where this system (bonuses) has been in effect, such as Pennsylvania, populations have increased." (Page 10.)

(vi) Scalp numbers in Western Australia have followed irregular cycles which generally speaking all the scalps—wild dogs, foxes, wedge-tailed eagles and emus—follow together. Alterations in bonus rates, usually for only one of the pests at a time, appear to have had little or only temporary effect on scalp numbers. Upward and downward trends have been maintained whether the bonus has been raised or lowered. On occasions scalps have increased when the bonus rate has been dropped, or have decreased when the amount has been raised. It is well known that foxes (which arrived in Western Australia about 1917) have greatly increased since uniform bonuses were first paid on them in 1928, when 1,407 scalps were received, to the record of over 52,000 in 1954-55. The bonus was originally £2 per head, but has fluctuated between 10s. and 2s. 6d. ever since; it is now 4s. (See graphs.)

A STUDY OF ARGUMENTS FOR AND AGAINST THE BONUS SYSTEM

While there is little doubt that the weight of the evidence is overwhelmingly against bonuses, some of the arguments in favour cannot be ignored. Points which require considering are:

(a) If there is no other outside assistance offering to those who are suffering from the depredations of a pest, bonuses must appear as at least providing some relief, and as being better than nothing. This same view point is adopted by some local and State authorities responsible for controlling vermin. If they have nothing better to offer, bonuses are the only assistance they can give.

(b) Providing landholders themselves are doing everything possible to deal with a pest, and the funds are not required for any other purpose, bonuses could be useful in inducing outsiders to assist and by subsidising control work by those who are hardest hit.

(c) It will be necessary for some acceptable alternative to the bonus system to be suggested and proved to the farmers and pastoralists before their reliance on the system can be altered. The task is not easy as so many people have come to accept and rely on bonus payments that they will take much convincing. In Western Australia, attempts to substitute organised drives for bonuses on foxes have met with such strong resistance, that the idea has been postponed while some organised drives are conducted as demonstrations of what is intended.

(d) The best alternative appears to be by direct assistance in the organising of carefully planned and coordinated control drives, aided by destruction teams and with field extension officers to advise with destruction techniques and to direct and organise destruction work. This boils down to having a definite control policy and well trained field officers to organise carefully planned control drives. Subsidies of destruction materials could assist but are not in themselves a direct control measure.

(e) It is up to the various State central vermin control authorities to evolve and apply these alternative schemes. Even if the facts show that the present bonus payments are mostly a waste of money, the arguments against them are largely ineffective unless there is something else offered which is not only better but acceptable.

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Apple seedling rootstocks in the nursery at Stoneville Research Station. These were sown in early August and photographed in the following March

The Raising of Seedling Apple Rootstocks

By J. CRIPPS, B.Sc. (Hort.), Horticultural Adviser

SEEDLING apple rootstocks are used extensively elsewhere in Australia and overseas and some interest is being shown in them locally by both nurserymen and fruit growers, firstly on account of the shortage of stocks and also because of their vigour. Prior to the war, Northern Spy was the favoured stock, but since the war, Pomme de Neige rootgrafts have been used extensively and more interest has been taken in seedlings.

In Western Australia some difficulty has been experienced in obtaining satisfactory germination of apple seed and it is considered that this is due to local climatic conditions in that sufficient cold is not normally experienced during the winter months to break dormancy. Apple seeds require a period of about two months with a temperature at or below 40° F. to provide them with a sufficient rest period, after which they germinate readily.

Most apple varieties can be used as a source of seed and it is usual to obtain seed from the most readily available source. Golden Delicious and Granny Smith have been tried experimentally and germinate very well. Nurserymen have also used Sturmers. Seed can be extracted from fruit rejected in the packing shed, but should, however, come from fruit which is as mature as possible.

SEED STORAGE

Seed for sowing should be cold stored during the late autumn and early winter months at a temperature of 32° F. to 40° F. by one of two methods; either in the whole fruit or in damp sand in sealed polythene bags after removal from the fruit. Both methods have their advantages and disadvantages.

Storage in sand involves a saving in space but is a more difficult technique since the sand must be neither too dry nor too moist, for both tend to inhibit germination.

Storage in the apples is a relatively foolproof method but a greater volume of storage space is occupied. In this case the seed is not removed from the apples until just before sowing. The method of

seed removal suggested is the cutting of the apple vertically into four quarters, but other methods may be utilised.

TIME OF SOWING

Sowing during the first fortnight in August has given good results, 85 per cent. germination having been obtained. In general, seed should be sown as early as possible since it should then make sufficient growth to enable budding to be carried out the following summer.

Preparation for sowing could include the removal of the top four inches of soil from the beds after which a dressing of blood and bone at one ton to the acre should be given plus a liberal dressing of animal or poultry manure. The mixture is then dug or rotary-hoed into the soil and the top four inches of soil previously removed is replaced.

Alternatively, the same dressing of blood and bone may be applied to the soil surface and cultivation and mixing carried out with a large rotary-hoe. Other methods may suggest themselves to growers but whichever method is employed the soil should be allowed to settle for a few days before sowing.

The suggested width of beds is three feet, with paths of the same width interposed, the seed being sown in four drills nine inches apart. A distance of approximately two inches should be allowed between individual seeds and they should be sown at a depth of one half to three quarters of an inch.

MANAGEMENT

When the seedlings reach a height of about eight inches, they should be thinned out to leave at least six inches between seedlings. During this thinning the opportunity should be taken to cull out weak and abnormal seedlings which should be destroyed leaving only the best, for it is not considered worthwhile using a second-rate seedling as the basis of an apple tree which it is hoped will live for 40 years. At the suggested spacing there will be approximately 1,000 seedlings for 125 feet of bed.

Frequent applications of water should be given throughout the summer months, watering at intervals of three days normally being sufficient. Watering at less frequent or irregular intervals may appreciably reduce growth.

Routine weeding should, of course, be carried out and the seedlings may be top-dressed with nitrogenous fertilisers. Providing that the seedlings have made sufficient growth, budding to named varieties may be carried out during January or early February. Budded seedlings should be planted out in nursery rows the following winter at a spacing to allow for mechanical cultivation between the rows.

This transplanting assists in the development of a satisfactory root system for seedling apples normally have a strong taproot and poorly-developed lateral roots. Transplanting cuts the taproot and leads to the development of a good lateral root system which is ideal for transplanting and establishment in the orchard.

Budded trees are cut back to the bud in the spring following transplanting and the young trees may be planted out in the orchard after having made one season's growth from the bud and only two years after the sowing of the seed.

It is therefore evident that the method of raising apple trees described facilitates the production of trees in a comparatively short period and is also a relatively cheap and simple method. Named varieties budded on to seedling stocks normally make vigorous growth but show no resistance to woolly aphid. If grown under good conditions trees are usually large and long-lived, although some variation in the growth and cropping of individual trees may be exhibited.

The overall response of apples on seedling stocks to local conditions is however largely unknown. The increased vigour will require some modification of pruning practices to encourage early cropping and under dry conditions difficulty may be experienced in bringing the fruit up to size so that the possibility of irrigation needs to be considered.